FLUCTUATIONS IN THE COMMERCIAL FISHERIES OF SAGINAW BAY

1885–1956

RESEARCH REPORT 51

FISH AND WILDLIFE SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

Digitized by the Internet Archive
in 2026

https://archive.org/details/research-report-fish-and-wildlife-service_1959_51

FLUCTUATIONS IN THE COMMERCIAL FISHERIES OF SAGINAW BAY 1885–1956

By RALPH HILE
Fishery Research Biologist

and HOWARD J. BUETTNER
Statistician

RESEARCH REPORT 51

FISH AND WILDLIFE SERVICE
Arnie J. Suomela, *Commissioner*

UNITED STATES DEPARTMENT OF THE INTERIOR
Fred A. Seaton, *Secretary*

UNITED STATES GOVERNMENT PRINTING OFFICE • WASHINGTON • 1959

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington 25, D.C. - Price 25 cents

Library of Congress catalog card for this report:

Hile, Ralph Oscar, 1904–
Fluctuations in the commercial fisheries of Saginaw Bay, 1885–1956, by Ralph Oscar Hile and Howard John Buettner. Washington, U. S. Govt. Print. Off., 1959.

iv, 38 p. diagrs., tables. 23 cm. (U. S. Fish and Wildlife Service. Research report 51)

Bibliography: p. 31–32.

1. Fisheries—Saginaw Bay. I. Buettner, Howard John, joint author. II. Title. (Series)

[SH11.A3 no. 51] Int 59–42

U. S. Dept. of the Interior. Library
for Library of Congress

CONTENTS

	Page
Introduction	1
Statistical sources and methods	2
Sources of statistics	2
Methods of analysis	4
Trends of production, 1885–1956	5
Total production	7
Lake trout	7
Whitefish	7
Lake herring	9
Walleye	9
Yellow perch	11
Suckers	11
Carp	12
Catfish	13
Changes in species composition	14
Seasonal trends in production and gear composition of the catch, 1929–56	15
Seasonal distribution of the catch	15
Gear composition of the catch	16
Interrelation of production, abundance, and fishing intensity, 1929–56	18
Lake trout	20
Whitefish	21
Lake herring	22
Walleye	23
Yellow perch	25
White and redhorse suckers	27
Carp	27
Catfish	28
Outlook for Saginaw Bay fisheries	30
Literature cited	31
Appendix	33

Approved for publication March 24, 1958. Research Report 51.

ABSTRACT

Total commercial production (millions of pounds) has fluctuated as follows: 1885–93, 7.2; 1894–1900, 10.0; 1901–04, 12.4; 1905–16, 9.9; 1917–29, 6.0; 1930–39, 8.2; 1940–43, 6.3; 1944–48, 5.1; 1949–55, 4.0; 1956, 2.8. Maximum and minimum catches in single years were 14.2 million pounds in 1902 and 2.8 million in 1956. Actual and percentage contributions of individual species to the total catch have varied widely, but the major change of species composition has occurred since 1943. By the early 1940's carp had taken over top position from the traditionally dominant lake herring. The four principal species and their percentage contributions in three periods were for 1891–1917—lake herring (43.1), yellow perch (19.2), suckers (16.9), walleye (11.9); 1918–43—lake herring (40.2), walleye (15.9), suckers (14.4), carp (10.9); 1944–56—carp (29.7), lake herring (20.2), suckers (19.8), yellow perch (9.6).

In 1929–56 production was seasonal for all principal species. The quarter of maximum production and the percentage of total annual take produced in the quarter were for lake trout—summer, 38.8; whitefish—summer, 61.2; lake herring—fall, 76.8; walleye—spring, 83.1; yellow perch—fall, 64.9; suckers—fall, 46.3; carp—spring, 67.3; catfish—spring, 64.8. Major gears of production have been shallow trap nets, haul seines, and pound nets (this last gear has been of little importance since 1940). Of lesser significance have been gill nets, fyke and hoop nets, set hooks, and certain miscellaneous methods of capture.

The interrelations of production, abundance (or availability), and fishing intensity in 1929–56 are described for the eight principal species. Three of the higher-priced species (lake trout, whitefish, walleye) have been scarce most of the last 10 to 20 years, particularly in the most recent ones. Of the species that command a generally good price in a strong market, only the catfish remains plentiful. Lake herring (though very scarce in 1955–56), yellow perch, suckers, and carp have been plentiful in recent years but profits from the exploitation of these low-priced fish are meager. As a result, fishing pressures have been dwindling and the trend of total production has been strongly downward. The outlook for the fishery is poor. Profitable operation calls for restoration of some of the higher-priced species and this restoration in turn must await effective control of sea lampreys and a subsequent rehabilitation of fish stocks.

FLUCTUATIONS IN THE COMMERCIAL FISHERIES OF SAGINAW BAY, 1885–1956

This report has been prepared to place under a single cover the principal statistical data available on the Saginaw Bay fisheries. As research on this important fishing area expands, the continued reference by investigators to scattered publications and to hand-written file records becomes increasingly burdensome. Furthermore, the interest of the industry, administrators, and others in these potentially productive but currently distressed fisheries is sufficient to give this compilation a more general usefulness.

Many of the production records and some of the data on fishing intensity and abundance have appeared in earlier publications (Hile 1937, 1949, 1954; Hile and Jobes, 1941; Gallagher and Van Oosten, 1943;[1] Van Oosten, Hile, and Jobes, 1946; El-Zarka 1959) but most of these presentations were concerned with special problems, usually related to a single species, and hence did not provide a good historical view of the general fishery.

Common names of fishes are employed in this article throughout the text and in the tables. The following list of common and scientific names generally follows the recommendations of the American Fisheries Society. Where the common name deviates from those recommendations the difference is indicated by the supplemental word or alternative name in parentheses.

Black bass	*Micropterus* spp.
Bowfin	*Amia calva*
Buffalo (black)	*Ictiobus niger*
Bullheads	*Ictalurus* spp.
Burbot	*Lota lota*
Carp	*Cyprinus carpio*
Catfish (channel)	*Ictalurus punctatus*
Chubs	*Coregonus* spp.
Gizzard shad	*Dorosoma cepedianum*
Lake herring	*Coregonus artedi*
Lake trout	*Salvelinus namaycush*
Mooneye	*Hiodon tergisus*
Northern pike	*Esox lucius*
Rock bass	*Ambloplites rupestris*
Round whitefish	*Prosopium cylindraceum*
Sauger	*Stizostedion canadense*
Sea lamprey	*Petromyzon marinus*
Sheepshead (freshwater drum)	*Aplodinotus grunniens*
Smelt (American)	*Osmerus mordax*
Sturgeon (lake)	*Acipenser fulvescens*
Suckers:	
White	*Catostomus commersoni*
Longnose	*C. catostomus*
Redhorse	*Moxostoma* spp.

[1] These authors published catch records through 1940 for all but the least important species.

Walleye	*Stizostedion vitreum*
White bass	*Roccus chrysops*
Whitefish (lake)	*Coregonus clupeaformis*
Yellow perch	*Perca flavescens*

It is highly questionable whether the buffalo can be listed properly as a commercial species in Saginaw Bay. Although small catches were reported for certain earlier year (see appendix table 1, p. 34) our firs verified record of the occurrenc of buffalo in Lake Huron was ob tained in the spring of 1958. It ha been suggested by Reeve M. Baile that the term "buffalo" may hav been applied to catches of quillbac (*Carpiodes cyprinus*).

STATISTICAL SOURCES AND METHODS

Sources of Statistics

The records for 1885 were taken from Smith and Snell (1891).

The statistics for 1891–1908 were obtained from hand-written records made available to us by the Michigan Department of Conservation and compiled with the aid of W. P. A. personnel. The record books which contain summaries of annual surveys by State of Michigan agents list the catches by species and by port. These books were well kept and give every evidence of year-to-year consistency in method of collection and tabulation. Usable records on catch by gear were few but, fortunately, ambiguity as to identity of species likewise was limited. A most annoying usage for some areas—the combination of catches of lake herring and chubs (deepwater ciscoes) in certain years—affected Saginaw Bay but little, since few chubs are produced in the area. Evidence suggests that in some years the catch of black bass may have included rock bass and white bass (a species very scarce in the Bay) but again, these minor "basses" sometimes may have been placed under Miscellaneous. Thi category of Miscellaneous, which in cluded 70,000 to 674,000 pounds pe year over the 1891–1908 period, i the most troublesome feature of th statistics. It not only deprives us o knowledge of the take of numerou minor species but also throws som doubt on the completeness of th records of some of the cheaper spe cies for which statistics are listed It is always possible, for exampl that that part of the production such low-priced fish as suckers ma have been placed under Miscellan ous. Despite these few systemat defects, however, the 1891–1908 st tistics were carefully collected an compiled.

The records for 1916–28 were o tained from the published reports the Michigan Department of Co servation and its administrati predecessors. The sometimes erra ic fluctuations of the annual tot suggest a possible year-to-year va ability in the efficiency of collecti the statistics, and in one year (19 the evidence is substantial that fair part of the catch of carp, least, was not recorded. Statist on carp, miscellaneous, and to

roduction (in thousands of pounds) n 1916–18 were as follows:

Year	Carp	Miscellaneous	Total
916	---	684	10,569
917	---	37	5,244
918	633	73	7,957

No catches of carp were recorded in 916 or 1917. In the former year he substantial poundage (684,000) nder Miscellaneous probably was ufficient to include the take of carp, ut in 1917 the miscellaneous catch vas only 37,000 pounds. Yet the arge production of carp in 1918 633,000 pounds) indicates that an ctive fishery for the species must ave been in progress in the preced- ng years. Thus, we have good evi- lence that most of the carp produc- ion of 1917 was not recorded. Fur- hermore, incompleteness of the lata probably was not limited to his single species. Suspicion as to he completeness of the 1917 sta- istics is heightened by the low total roduction (5,244,000 pounds) as ompared with 1916 (10,569,000 ounds) and 1918 (7,957,000 ounds).

The preceding argument is, to be ure, not conclusive. The annual atches could have varied as shown nd a fishery for carp could have tarted suddenly in 1918. Yet a olid basis for skepticism exists and t would be misleading not to bring ttention to doubts as to the relia- ility of the statistics for 1917 and ossibly for other years (as 1921, 923–24, and 1928) in which the ake dropped suddenly to extremely ow levels.

The statistics for 1929 and later ears were obtained from commercial fishing reports submitted to the Michigan Department of Conservation each month by all licensed operators and turned over to the Fish and Wildlife Service for tabulation and analysis. These reports provided for a daily record of the amount of gear fished and of the catch in pounds by species. It is not possible to judge precisely the reliability of records obtained from these monthly reports, but such information as has been obtained over the years indicates that with a single exception, they are reasonably dependable. The exception came in the early 1930's when proposed restrictions on the deep trap net were a subject of bitter controversy. It is known that in those years (approximately 1930–33), some operators failed by a good margin to report their entire catch of whitefish. Others, on the contrary, gave accurate reports during the entire dispute. For other years and other species the records are believed to be sound. The large producers, in particular, submit scrupulously accurate reports, and the reports of smaller operators, although based on less-professionally maintained records are believed to be mostly free of bias.

The monthly reporting system unquestionably has given us the most comprehensive and reliable statistics ever obtained on the Great Lakes fisheries. Furthermore, care in preparation of reports grows as fishermen repeatedly see the records used for the benefit of the industry.

A difficulty in the comparison of statistics for 1929 and later with those for earlier years arises from a difference in the geographical area

covered by "Saginaw Bay." The Bay of recent years has included, in addition to Saginaw Bay proper, the adjacent waters of Lake Huron south of an east-west line through Au Sable Point and north of a line running in a northeasterly direction from Port Hope (fig. 1). Catches of gear lifted within these geographical limits were credited to the Saginaw Bay district regardless of the home port of the operator. In 1885, 1891–1908, and 1917–28, on the contrary, the Saginaw Bay catches were the landings of fishermen from Saginaw Bay ports. Because of this difference, the statistics before 1929 did not include any catches of Oscoda fishermen who set their nets to the southward in waters of the present Saginaw Bay district (fishing in the Saginaw Bay district by Harbor Beach fishermen occurs so rarely that it can be ignored). Of the major commercial species, only whitefish and lake trout were affected significantly by the change in 192 in the handling of the statistic According to Van Oosten, Hile, an Jobes (1946), Oscoda fishermen a counted for about 14 percent of th whitefish production of the Sagina Bay district in 1929 and 1930; th corresponding figure for lake trou in the same years was 63 percen Because we lack knowledge of poss ble changes in fishing habits an grounds over the years, no adjus ments have been made to compe sate for the change in method tabulation. It should be remem bered, however, that catch recor for whitefish and especially for la trout prior to 1929 are underes mates in comparison with those f 1929 and later.

Methods of Analysis

Procedures for the analysis of st tistics of the commercial fisheries the Great Lakes have been c

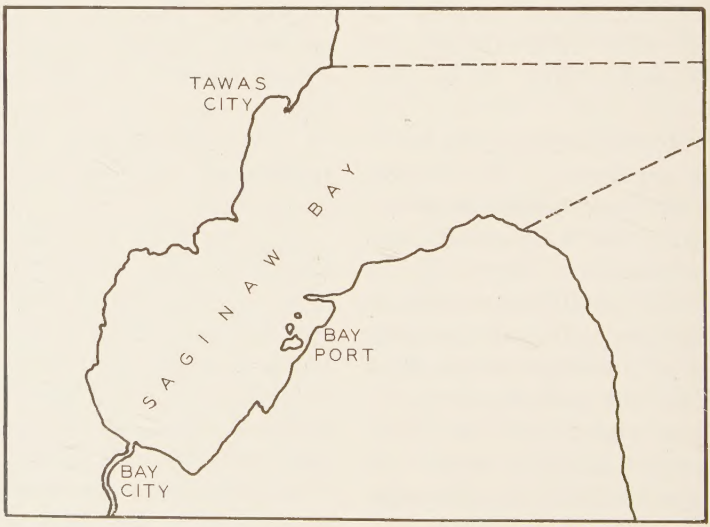


Figure 1.—Saginaw Bay area. The broken lines show the boundaries of the Saginaw district established in 1929.

scribed by Hile (1937), Hile and Jobes (1941), and Van Oosten, Hile, and Jobes (1946); consequently, no detailed comments are required here. It may be mentioned nevertheless that estimates of abundance or availability are based on records of the catch in pounds per standard unit of fishing effort and that estimates of the intensity of the fishery for a particular species are based only on gear lifted on days when some quantity of the species was taken by the fisherman submitting the report.

Most of the tables were compiled originally from records to the nearest pound and subsequently rounded; hence, the items do not always add exactly to the totals.

TRENDS OF PRODUCTION, 1885–1956

Catch statistics are given in table for only the major species and for total production. Details on the lake of minor species, including the miscellaneous or unidentified catch in certain earlier years, are to be found in appendix table 1, page 34. In the arrangement of table 1 horizontal spaces indicate interruptions in the sequence of years for which statistics are available or a major change in the method of collection between 1928 and 1929—see previous section).

Comments on the trends of total production and of the catch of individual species are brief and based largely on text tabulations of the mean annual catch and the range of the catch over selected periods of years. Judgment as to years to be included in periods frequently was arbitrary, and sound argument can be made for extension or shortening, for subdivision or combination. They are used only for the convenience of the reader and not intended to supersede the original records of annual catch.

able 1.—Production (thousands of pounds) of eight principal species and total production in the commercial fisheries of Saginaw Bay, 1885–1956

[See appendix table 1, p. 34, for details on catch listed under Other]

Year	Lake trout	White-fish	Lake herring	Wall-eye	Yellow perch	Suckers	Carp	Catfish	Other	Total
85	589	168	1,020	673					5,130	7,580
91	159	92	2,325	1,558	1,103	906		119	160	6,423
92	167	160	1,686	1,035	1,802	1,640		113	211	6,814
93	186	200	2,972	686	1,692	2,059		96	240	8,131
94	88	117	3,112	1,885	2,014	2,704		121	306	10,347
95	73	204	3,515	878	1,754	3,164		107	198	9,893
96	94	264	5,832	723	1,577	1,217		156	235	10,098
97	87	285	4,318	1,217	1,539	1,340		231	301	9,318
98	97	249	4,759	1,242	2,188	1,065		214	275	10,089
99	54	307	3,904	1,167	2,804	1,047		434	422	10,139
00	43	192	3,908	800	3,453	1,342		268	343	10,349
01	31	264	6,322	716	3,379	1,355		134	400	12,601
02	60	332	8,490	1,003	2,384	1,413		158	342	14,182
03	59	436	5,068	1,771	2,069	1,622		113	479	11,617
04	47	304	5,851	1,652	1,529	1,389		82	359	11,213
05	59	208	3,677	1,415	1,572	2,316		68	741	10,056
06	63	198	2,684	1,044	1,748	3,002		114	672	9,525
07	84	283	4,180	980	1,935	2,755		69	646	10,932
08	55	271	4,811	801	1,086	841		63	279	8,207

Table 1.—Production (thousands of pounds) of eight principal species and total production in the commercial fisheries of Saginaw Bay, 1885–1956—Continued

[See appendix table 1, p. 34, for details on catch listed under Other]

Year	Lake trout	White-fish	Lake herring	Wall-eye	Yellow perch	Suckers	Carp	Catfish	Other	Total
1916	48	1,203	5,322	654	1,638	1,012			692	10,569
1917	43	209	2,820	1,002	643	490			37	5,244
1918	36	130	3,847	1,803	789	641	633		78	7,957
1919	132	176	3,883	1,246	1,018	1,135	1,104	38	120	8,852
1920	11	201	2,442	758	804	1,164	813	12	56	6,261
1921	13	224	1,334	546	659	1,028	845	16	42	4,707
1922	18	319	3,003	1,098	461	1,214	1,038	30	58	7,239
1923	9	218	1,830	622	573	704	296	17	76	4,345
1924	9	218	1,714	314	444	408	467	30	111	3,715
1925	113	250	3,736	335	414	602	396	61	125	6,032
1926	101	497	3,326	589	342	855	349	117	103	6,279
1927	53	525	4,005	621	113	1,582	1,892	176	99	9,066
1928	15	235	738	630	192	859	255	162	150	3,236
1929	200	572	1,563	632	441	1,193	387	166	150	5,304
1930	264	1,043	3,542	1,004	612	1,687	808	82	344	9,386
1931	325	1,948	3,656	681	656	1,183	848	31	346	9,674
1932	304	2,463	2,040	1,375	588	1,292	1,002	31	143	9,238
1933	246	762	1,908	1,455	331	1,069	960	43	153	6,927
1934	162	195	3,360	1,349	399	1,136	1,007	36	141	7,785
1935	60	213	2,846	1,293	837	803	1,033	55	231	7,371
1936	38	129	3,165	1,401	1,074	936	732	94	99	7,668
1937	96	155	3,310	1,529	351	922	959	115	64	7,501
1938	90	56	4,202	1,179	327	780	609	131	72	7,444
1939	89	26	5,591	1,492	441	748	638	114	61	9,200
1940	77	32	2,715	1,443	441	880	514	236	49	6,387
1941	91	12	2,552	1,463	332	820	634	382	56	6,34
1942	60	7	1,793	2,050	460	683	581	392	71	6,09
1943	70	16	1,448	1,558	883	892	1,085	382	78	6,41
1944	74	26	629	988	536	740	832	310	82	4,21
1945	14	32	844	560	353	813	2,145	375	123	5,25
1946	2	265	986	909	281	1,214	1,462	249	110	5,47
1947	1	1,326	713	366	251	932	1,232	267	109	5,19
1948	1	831	1,120	142	640	821	1,345	189	134	5,22
1949	(1)	80	1,352	78	447	630	859	164	53	3,66
1950	(1)	5	1,221	62	322	642	984	157	143	3,53
1951		18	920	65	307	904	1,439	223	247	4,12
1952	(1)	21	1,333	55	422	941	1,398	295	256	4,72
1953		6	1,006	67	394	971	1,154	320	251	4,16
1954		3	1,011	71	433	1,060	1,262	243	258	4,34
1955		(1)	258	61	488	889	1,273	349	277	3,64
1956		(1)	62	71	329	536	1,164	330	309	2,84

[1] Less than 500 pounds.

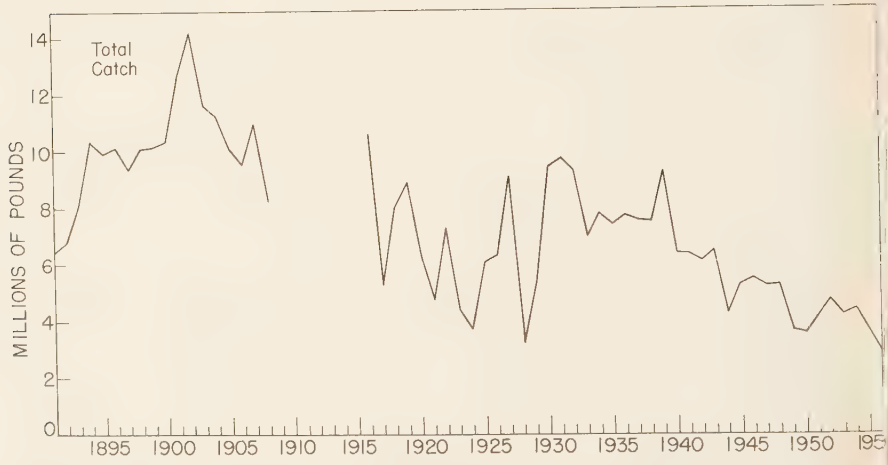


Figure 2.—Total production (all species combined) in the commercial fisheries of Saginaw B 1891–1956.

Total Production

The history of the total commercial production in Saginaw Bay has been one of gradual buildup to a peak just after the turn of the century, followed by a progressive decline to the low level of output of the most recent years (fig. 2). The nature of this trend is brought out by the following record of the mean annual take for selected periods:

Years	Catch (millions of pounds)	
	Average	Range
1885–93	7.2	6.4– 8.1
1894–1900	10.0	9.3–10.3
1901–04	12.4	11.2–14.2
1905–16	9.9	8.2–10.9
1917–29	6.0	3.2– 9.1
1930–39	8.2	6.9– 9.7
1940–43	6.3	6.1– 6.4
1944–48	5.1	4.2– 5.5
1949–55	4.0	3.5– 4.7
1956	2.8	

The decline from the peak annual production of 12.4 million pounds in 1901–04 had one interruption: the average take in 1917–29 (6.0 million pounds) was below that of the next two periods, 1930–39 (average, 8.2 million pounds) and 1940–43 (6.3 million pounds). This interruption actually may have been less pronounced than the figures indicate. For reasons outlined in the preceding section, there is cause to suspect the completeness of the collection of the statistics in certain years of the earlier period.

The rate of decline has been high in recent decades. The average catch of 4.0 million pounds in 1949–55 was only half the 1930–39 take of 8.2 million pounds (less than one-third the peak production of 1901–04). Even more alarming was the all-time record low of only 2.8 million pounds in 1956. A continuation of recent trends soon will bring the Saginaw Bay fisheries to insignificant production.

Lake Trout

Because of the effects of the change in 1929 in the area covered in the statistics for this species (see section on Sources of Statistics, p. 4), comparisons between statistics for the years before 1929 and those for later years would be meaningless in the following tabulation:

Years	Production (thousands of pounds)	
	Average	Range
1885–1928	84	9–589
1929–34	250	162–325
1935–44	74	38– 96
1945–56	2	0– 14

The take in the period 1885–1928 (fig. 3) varied widely and erratically; much of the variability, no doubt, can be attributed to the tabulation of the catch by port (of landing or of residence of the operator). In 1929–34, the first period for which the area covered is known certainly to include adjacent waters of Lake Huron as well as Saginaw Bay proper, the take averaged a quarter million pounds. The slump to a yearly mean of 74,000 pounds in 1935–44 and the disappearance of the lake trout fishery in the later years of the 1945–56 period can be attributed to the destruction of lake trout by sea lampreys. Hile (1949) discussed these statistics through 1946.

Whitefish

Although the change in 1929 in the fishing area covered by the

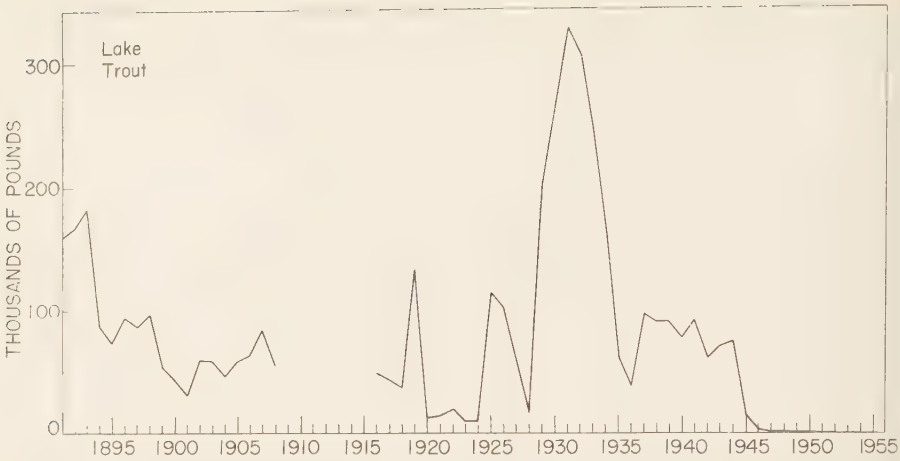


Figure 3.—Production of lake trout in the commercial fisheries of Saginaw Bay, 1891–1956.

statistics (see section on Sources of Statistics, p. 4) surely had some biasing effects on the records, these effects probably were not sufficient to impair greatly the validity of comparisons of data before 1929 with those of 1929 and later in the following tabulation:

Years	Production (thousands of pounds)	
	Average	Range
1885–95	157	92– 204
1896–1908	276	192– 436
1916	1,203	
1917–25	216	130– 319
1926–29	457	235– 572
1930–32	1,818	1,043–2,463
1933–37	291	129– 762
1938–45	26	7– 56
1946–48	807	265–1,326
1949–56	17	0– 80

Production of whitefish in the earlier years of record was moderate but fairly stable (fig. 4). The take averaged 157,000 pounds in 1885–95 but rose to a higher level in 1896. Despite substantial annual fluctuations and some short periods of relatively high or low yield, the production can be described as largely without clear trend for many years after 1895. Indeed, a combination of all the years of the 1896–1925 interval into a single period would have been justifiable except for the unusually high take of 1,203,000 pounds in 1916. No comments are offered on this unusual figure.

The 1926–29 interval saw the start of the modern era of alternating periods of extremely high and extremely low production of whitefish. The good average of 457,000 pounds in those years was followed by the phenomenal average of 1,818,000 pounds in 1930–32 (all-time peak of 2,463,000 pounds in 1932). The output then fell away sharply to an average of 291,000 pounds in 1933–37 and only 26,000 in 1938–45. Still another period of exceptionally high production in 1946–48 (average, 807,000 lb.) has been followed by a very low take (average, 17,000 lb.) in 1949–56. In the last year of the period the reported catch was below 100 pounds.

Van Oosten, Hile, and Jobe (1946) gave detailed discussion of whitefish statistics through 194

with special reference to problems arising from the development and extensive use of the deep trap net.

Lake Herring

This species always has been a major component of the commercial catch in Saginaw Bay, but the level of production has fluctuated over a wide range, as is indicated by the following record:

Years	Production (thousands of pounds)	
	Average	Range
1885–94	2,223	1,020–3,112
1895–1900	4,373	3,515–5,832
1901–04	6,433	5,068–8,490
1905–19	3,903	2,684–5,322
1920–42	2,799	738–5,591
1943–54	1,049	629–1,448
1955–56	160	62– 258

The trend in production of lake herring has resembled that of total output, in that the level of take rose during early years to a maximum just after 1900, and then declined to a low figure in the most recent years (fig. 5). The average annual catch rose successively from 2.2 million pounds in 1885–94 to 4.4 million in 1895–1900 and 6.4 million in 1901–04 (record take of 8,490,000 pounds in 1902). The average then dropped to 3.9 million pounds in 1905–19, 2.8 million in 1920–42, 1.0 million in 1943–54, and only 160,000 in 1955–56. The year-to-year variability was high after 1919.

Walleye

The catch in 1885 was only 673,000 pounds but a higher level of productivity was reached by 1891 (fig. 6). Trends are indicated by the following tabulation:

Years	Production (thousands of pounds)	
	Average	Range
1885	673	
1891–1919	1,149	654–1,855
1920–31	652	314–1,098
1932–44	1,429	988–2,050
1945–56	209	55– 909

Relatively good takes persisted through 1919 (1891–1919 mean, 1,149,000 pounds). The catch fell away in 1920–31 (average, 652,000 pounds) but rose to a new high average of 1,429,000 pounds in 1932–44

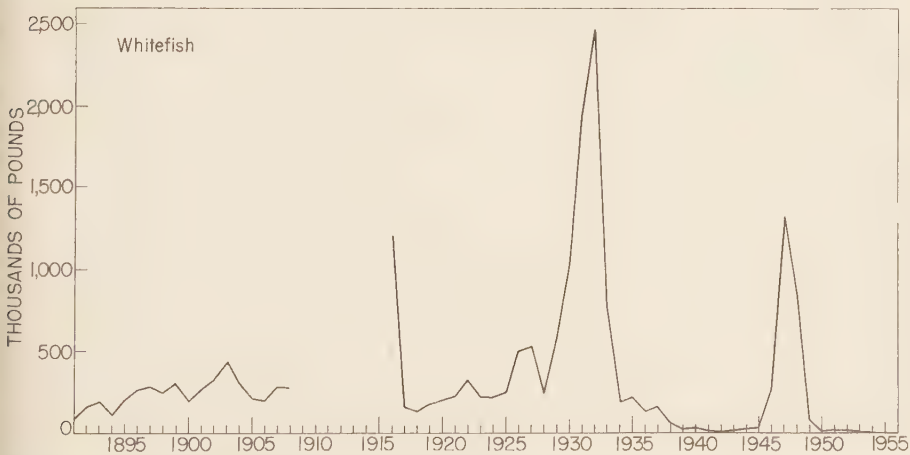


Figure 4.—Production of whitefish in the commercial fisheries of Saginaw Bay, 1891–1956.

Figure 5.—Production of lake herring in the commercial fisheries of Saginaw Bay, 1891–1956.

Figure 6.—Production of walleye in the commercial fisheries of Saginaw Bay, 1891–1956.

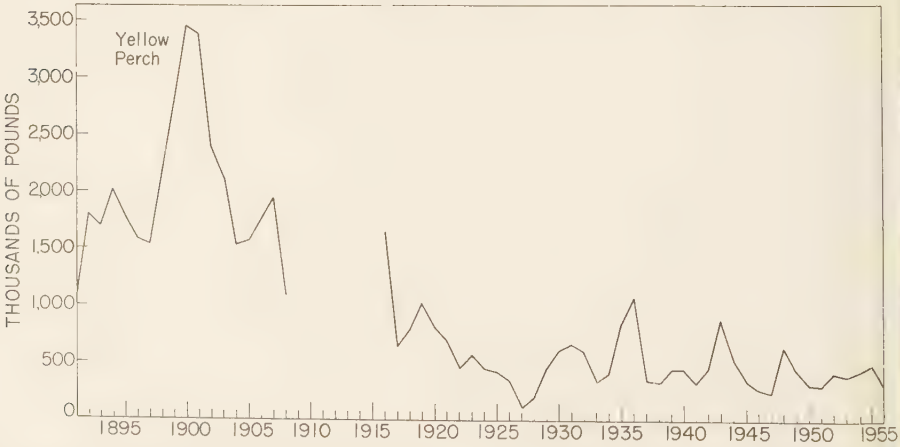


Figure 7.—Production of yellow perch in the commercial fisheries of Saginaw Bay, 1891–195

(alltime maximum of 2,050,000 pounds in 1942). The last year of this period (1944) saw the start of a decline which was to bring the walleye fishery to disaster. The decline is not reflected adequately in the 1945–56 mean of 209,000 pounds—the annual catch has been below 100,000 pounds since 1949.

Production statistics for Saginaw Bay walleyes through 1951 were discussed briefly by Hile (1954).

Yellow Perch

The statistics on production of yellow perch in Saginaw Bay divide themselves neatly into two periods:

Years	Production (thousands of pounds)	
	Average	Range
1891–1916	1,961	1,086–3,453
1917–56	496	113–1,074

Despite the considerable range of variability in the catch of perch in both periods and the occurrence of short intervals of relatively high or low output (fig. 7), it is not possible to speak of a trend within either period. Production did not once fall below 1 million pounds before 1917 and it exceeded that figure only twice (1919 and 1936) after 1916. The alltime high was 3,453,000 pounds in 1900 and the record low was 113,000 pounds in 1927.

Hile and Jobes (1941) discussed statistics on Saginaw Bay yellow perch through 1938 and El-Zarka (1959) through 1955.

Suckers

Comparability of the data on suckers for earlier and later years is impaired slightly by the separate tabulation, beginning in 1929, of the longnose sucker, a species of very limited commercial value. The damage to the comparison is small, however, as can be seen from the record of take of the longnose sucker (appendix table 1, p. 34). Of possibly greater significance may have been the inclusion of part of the sucker catch under Miscellaneous in those early years in which that category of unidentified catch existed. We have no proof that any part of the sucker catch was included under Miscellaneous (except for 1885) but the possibility should not be ignored. It is believed, nonetheless, that the following statistics give a good general idea of productivity in different periods:

Years	Production (thousands of pounds)	
	Average	Range
1891	906	.....
1892–1907	1,839	1,047–3,164
1908–28	895	408–1,582
1929–34	1,260	1,069–1,687
1935–56	844	536–1,214

The take of suckers in 1891 was only 906,000 pounds, but over the next 16 years (1892–1907) production did not once fall below 1 million pounds and exceeded 3 million pounds in 1895 (alltime high of 3,164,000) and 1906 (fig. 8). The 1892–1907 average of 1,839,000 pounds was the highest for any extended period. The output fell away sharply in 1908 and averaged only 895,000 pounds in the period 1908–28. A second relatively short period of high production (average of 1,260,000 pounds in 1929–34) has been followed by a 22-year interval of fairly steady yield at a new low average of 844,000 pounds.

Figure 8.—Production of suckers in the commercial fisheries of Saginaw Bay, 1891–1956. All species of suckers are included through 1928; longnose suckers are excluded in 1929 and later.

Figure 9.—Production of carp in the commercial fisheries of Saginaw Bay, 1918–56.

Carp

Since the maintenance of statistics on the yield of carp was started, the trend of production has been gradually upward:

Years	Production (thousands of pounds)	
	Average	Range
1918–29	706	255–1,892
1930–44	816	514–1,085
1945–56	1,310	859–2,145

The earlier years, 1918–29, were a period of wide and sometimes er ratic variability (fig. 9). Some o this variability may reflect the e forts of a relatively new fishery t adjust to its market; it is possibl also that collection of statistics wa faulty in certain years (see sectio on Sources of Statistics, p. 2). T the second period, 1930–44, the an nual catch varied much less than i preceding years and the averag

(816,000 pounds) was 110,000 pounds higher. Production jumped to an alltime high of 2,145,000 pounds in 1945. The average of 1,310,000 pounds for 1945–56 was almost a half million above that for 1930–44.

Catfish

It is believed that the statistics on catfish included most or all of the take of bullheads for years preceding 1919 and that the records for certain later years, as 1926 and 1927, may have included an unknown part of the take of bullheads. The 1885 catch of 808,000 pounds was listed specifically as bullheads (see appendix table 1, p. 34) but almost surely it included catfish, also. It is difficult to estimate the degree of bias from the possible inclusion of bullheads in the earlier years, but to judge from the records of output in more recent years (appendix table 1) it could have been considerable in periods of low abundance of catfish. The following statistics serve, nevertheless, to establish the catfish as a variety that has yielded relatively high and relatively low catches over some fairly extended periods of years:

Years	Production (thousands of pounds)	
	Average	Range
1891–1906	158	68–434
1907–25	28	12– 69
1926–29	155	117–176
1930–36	53	31– 94
1937–56	261	114–392

The 1885 take of 808,000 pounds of bullheads was by far the highest take of "catfish" ever reported for Saginaw Bay. We have no means of judging whether this yield reflects a typically high level of production of either bullheads or catfish in the early fishery. At any rate, the level was substantially lower when the collection of statistics was resumed in 1891. The 1891–1906 range of output was wide (68,000 to 434,000 pounds) and the average was 158,000. There followed four intervals of alternating low and high production in which the differences

Figure 10.—Production of catfish in the commercial fisheries of Saginaw Bay, 1919–56.

among the annual averages were large (fig. 10). The most recent period, 1937–56, has had the highest annual average (261,000 lb.) recorded for any substantial number of years.

Changes in Species Composition

Despite considerable year-to-year variability in the percentage of the total catch contributed by individual species, few important trends toward change of species composition developed until the most recent years (table 2; see appendix table 2 for records of percentage species composition in individual years). The differences between species composition in the periods 1891–1917 and 1918–43 were not large. Most significant, perhaps, was the establishment of a carp fishery that accounted for 10.9 percent of the total take in the more recent period (some carp were captured before 1918, of course, but the species did not receive a special listing). Important also was the large decrease in the percentage of the total take made up by yellow perch (from 19.2 in 1891–1917 to 8.1 in 1918–43). The changes among the other species were less consequential. The lake herring was strongly dominant in both periods (43.1 and 40.2 percent). The percentage contribution decreased for suckers but increased for lake trout, whitefish, walleye, and catfish. The actual significance of the changes for lake trout and whitefish is questionable (see the section on Sources of Statistics).

The figures for the most recent 13 years of record, 1944–56, show a greatly altered fishery. The percentage contribution of the traditionally dominant lake herring was cut approximately in half, and the species reduced to second place. First place was held by carp (29.7 percent), an introduced species that was not even listed before 1918 and which made up only 10.9 percent of the take in the period 1918–43. Other species that experienced small to substantial increases were yellow perch, suckers, and catfish. The percentages for lake trout, whitefish, and walleye, on the other hand, decreased sharply. Indeed, by the end of the period lake trout and whitefish had quite or almost disappeared from the fishery and walleye had leveled off at a commercially unimportant production.

Table 2.—Average percentage contribution of principal species to the commercial fisheries of Saginaw Bay over three periods

[Unweighted means of percentages for individual years]

Item	Lake trout	Whitefish	Lake herring	Walleye	Yellow perch	Suckers	Carp	Catfish
1891–1917:								
Mean percentage	0.9	2.9	43.1	11.9	19.2	16.9	----------	[1] 1.5
Range	0.2–2.5	1.1–11.4	24.7–59.9	5.7–24.3	12.3–33.4	9.3–32.0	----------	0.6–4
1918–43:								
Mean percentage	1.4	5.5	40.2	15.9	8.1	14.4	10.9	[2] 1.9
Range	0.2–3.8	0.1–26.7	22.1–61.8	5.6–33.6	1.2–14.0	8.1–26.5	5.6–20.9	0.2–6
1944–56:								
Mean percentage	0.2	3.9	20.2	5.7	9.6	19.8	29.7	6.4
Range	0.0–1.8	[3] 0.0–25.5	2.2–36.9	1.2–23.4	4.8–13.6	15.5–24.7	19.7–41.6	3.6–1

[1] No data for 1916 and 1917.
[2] No data for 1918.
[3] Less than 0.05.

SEASONAL TRENDS IN PRODUCTION AND GEAR COMPOSITION OF THE CATCH, 1929–56

Seasonal Distribution of the Catch

The seasonal trends in production of five of the eight principal species have been affected by the imposition of closed seasons. The effects of closure have been especially important since, with the exception of the walleye, the closed periods have covered much or all of the spawning season. The actual opening and closing dates have been modified from time to time, but a review of all changes hardly seems necessary. A general idea of the time covered can be had from the seasons in effect in 1956: Lake trout, October 1–31; whitefish, November 1–December 1; walleye, March 5–April 10; yellow perch, April 15–May 10; suckers, April 15–May 20. Seasons open or close at 12:00 noon of the days listed.

Comments on the data on seasonal trends of production (tables 3 and 4) will be limited largely to the records of percentages for months and quarters, since the actual production figures were reviewed briefly in the preceding section and are described in some detail in later observations on catch in relation to abundance and fishing intensity.

The production of all principal species in Saginaw Bay in the period 1929–56 was seasonal—strongly so for some. The actual time, month or quarter, of greatest take varied from one species to another. For all, however, the catch in the first, or winter, quarter was relatively small. The general situation, perhaps, can be summarized best by the following listing for each species of the percentages for the 2 months

Table 3.—Percentage distribution, by month and quarter, of the average annual catch of the principal species in Saginaw Bay, 1929–56

[Some production of each species was reported for each month; percentages less than 0.05 are recorded as 0.0]

Period of time	Lake trout	Whitefish	Lake herring	Walleye	Yellow perch	White and redhorse suckers	Carp	Catfish
Month:								
January	1.2	0.0	0.1	0.0	3.2	2.6	1.9	0.1
February	0.4	0.0	0.3	0.0	1.4	2.8	3.4	0.8
March	3.0	0.1	0.3	0.0	3.3	7.3	2.4	0.7
April	6.5	1.3	2.0	56.9	5.8	12.1	17.2	13.7
May	9.0	3.8	9.8	19.4	1.0	6.0	33.5	32.6
June	8.3	13.1	8.7	6.8	2.8	4.8	16.6	18.5
July	16.2	19.6	1.7	4.1	2.1	3.0	6.1	6.6
August	13.8	20.9	0.1	0.7	2.6	1.6	2.8	2.1
September	8.8	20.7	0.2	2.9	12.9	13.5	4.6	7.5
October	1.6	16.1	16.3	6.3	42.8	27.8	5.6	10.6
November	19.9	4.3	58.2	2.9	19.0	16.4	5.1	6.5
December	11.3	0.1	2.3	0.0	3.1	2.1	0.8	0.3
Quarter:								
First	4.6	0.1	0.7	0.0	7.9	12.7	7.7	1.6
Second	23.8	18.2	20.5	83.1	9.5	22.9	67.3	64.8
Third	38.8	61.2	2.0	7.7	17.6	18.1	13.5	16.2
Fourth	32.8	20.5	76.8	9.2	64.9	46.3	11.5	17.4

Table 4.—Average annual catch (thousands of pounds), by month and quarter, of the principa species in Saginaw Bay, 1929–56

[Some production of each species was reported for each month; where no figure is given the catch was less than 5(pounds]

Period of time	Lake trout	White-fish	Lake herring	Walleye	Yellow perch	White and red-horse suckers	Carp	Catfish
Month:								
January	1		1		15	25	19	
February			7		7	26	34	
March	2		6		16	68	25	
April	5	5	39	476	28	113	175	2
May	7	14	192	162	5	56	339	6
June	7	48	172	56	13	44	168	3
July	13	72	34	34	10	28	61	1
August	11	76	3	6	13	15	29	
September	7	76	4	24	62	126	46	1
October	1	59	321	53	205	259	57	2
November	16	16	1,145	24	91	153	52	1
December	9		46		15	20	8	
Quarter:								
First	4		14		38	119	78	
Second	19	67	403	694	45	212	681	13
Third	31	224	41	64	84	169	136	
Fourth	27	75	1,512	77	310	432	117	
Total	81	366	1,970	835	478	933	1,012	20

and the quarter of greatest yield:

Lake trout:
- November, 20 percent
- July, 16 percent
- Third quarter, 38 percent

Whitefish:
- August, 21 percent
- September, 21 percent
- Third quarter, 61 percent

Lake herring:
- November, 58 percent
- October, 16 percent
- Fourth quarter, 77 percent

Walleye:
- April, 57 percent
- May, 19 percent
- Second quarter, 83 percent

Yellow perch:
- October, 43 percent
- November, 19 percent
- Fourth quarter, 65 percent

White and redhorse suckers:
- October, 28 percent
- November, 16 percent
- Fourth quarter, 46 percent

Carp:
- May, 33 percent
- April, 17 percent
- Second quarter, 67 percent

Catfish:
- May, 33 percent
- June, 18 percent
- Second quarter, 65 percent

Maximum production fell in th third, or summer, quarter only i lake trout and whitefish, speci that are produced mostly in wate adjacent to Saginaw Bay rath than in the bay itself. For the oth six species the greatest productio came in the spring (second) quart (walleye, carp, catfish) or fa (fourth) quarter (lake herring, ye low perch, suckers). Fishing activ ties are much reduced inside the ba in the third quarter, especially July and August.

Gear Composition of the Catch

The records of gear compositi of the catch (table 5) are given se

Table 5.—Average annual catch (thousands of pounds), by gear, for the principal species in Saginaw Bay, 1929–40 and 1941–56

[Percentages in parentheses; where no percentage is given the value was nil or less than 0.05. Mesh sizes of gill nets: small-mesh, 2½–2¾ inches, extension measure; large mesh, 4½ inches and greater]

Species and years	Small-mesh gill nets	Large-mesh gill nets	Pound nets	Deep trap nets	Shallow trap nets	Fyke and hoop nets	Haul seines	Set hooks	Other [1]	Total
Lake trout:										
1929–40	---	107 (66.1)	12 (7.1)	27 (16.5)	1 (0.8)	(2)	---	14 (8.4)	2 (1.1)	163
1941–56	(2)	18 (92.1)	(2)	1 (6.2)	(2) (0.6)	---	(2)	(2) (1.0)	---	20
Whitefish:										
1929–40	(2)	31 (4.9)	176 (27.9)	341 (53.9)	32 (5.1)	(2)	---	---	52 (8.2)	633
1941–56	---	3 (2.1)	(2) (0.3)	158 (95.5)	4 (2.1)	(2)	(2)	---	---	166
Lake herring:										
1929–40	79 (2.5)	(2)	2,283 (72.2)	2 (0.1)	773 (24.5)	1	(2)	---	21 (0.7)	3,158
1941–56	136 (12.6)	(2)	46 (4.2)	1 (0.1)	895 (83.0)	(2)	1 (0.1)	---	---	1,078
Walleye:										
1929–40	(2)	94 (7.6)	150 (12.1)	15 (1.2)	865 (70.0)	7 (0.5)	83 (6.7)	1 (0.1)	22 (1.8)	1,236
1941–56	(2)	25 (4.8)	2 (0.3)	1 (0.2)	453 (84.7)	2 (0.3)	52 (9.7)	(1)	(1)	535
Yellow perch:										
1929–40	55 (10.2)	(2)	23 (4.2)	1 (0.1)	395 (73.0)	42 (7.7)	21 (3.8)	1 (0.3)	4 (0.7	541
1941–56	20 (4.5)	(2)	3 (0.7)	(2)	342 (79.5)	55 (12.9)	9 (2.1)	1 (0.2)	(2) (0.1)	430
Suckers: [3]										
1929–40	1 (0.1)	17 (1.6)	65 (6.1)	5 (0.5)	695 (66.1)	70 (6.6)	186 (17.7)	---	14 (1.3)	1,052
1941–56	(2)	5 (0.5)	3 (0.3)	3 (0.3)	582 (69.1)	101 (12.0)	150 (17.8)	(2)	---	843
Carp:										
1929–40	(2)	11 (1.4)	12 (1.5)	(2)	118 (14.8)	44 (5.6)	606 (76.6)	(2)	1 (0.1)	792
1941–56	(2)	140 (11.9)	1 (0.1)	(2)	254 (21.6)	39 (3.3)	743 (63.1)	(2)	---	1,178
Catfish:										
1929–40	(2)	(2) (0.3)	2 (1.9)	(2) (0.1)	57 (60.3)	3 (3.1)	27 (28.9)	5 (5.4)	---	94
1941–56	(2)	3 (1.1)	1 (0.2)	(2) (0.1)	175 (60.4)	6 (1.9)	75 (26.1)	29 (10.2)	---	289

[1] Includes spears, hand lines, and dip nets; includes also catches for which gear was unknown (all in the earlier years of the 1929–40 period).
[2] Less than 500 pounds.
[3] White and redhorse suckers.

rately for the periods 1929–40 and 1941–56. The year 1941 was the first of a greatly lowered production by pound nets that was to reduce that gear to insignificance in the Saginaw Bay fishery. The near-disappearance of the pound net affected most severely the production of lake herring; the increase of lake in small-mesh gill nets and shallow trap nets failed by far to compensate the loss of the pound-net catch.

A brief summary of the gear composition of the catch of each of the principal species and a comparison between 1929–40 and 1941–56 are given in the following listing of percentages for gears that accounted for as much as 10 percent of the take.

Lake trout:

1929–40:

Large-mesh gill nets, 66 percent

Deep trap nets, 16 percent

1941–56:

Large-mesh gill nets, 92 percent

Whitefish:
- 1929–40:
  - Deep trap nets, 54 percent
  - Pound nets, 28 percent
- 1941–56:
  - Deep trap nets, 96 percent

Lake herring:
- 1929–40:
  - Pound nets, 72 percent
  - Shallow trap nets, 24 percent
- 1941–56:
  - Shallow trap nets, 83 percent
  - Small-mesh gill nets, 13 percent

Walleye:
- 1929–40:
  - Shallow trap nets, 70 percent
  - Pound nets, 12 percent
- 1941–56:
  - Shallow trap nets, 85 percent
  - Haul seines, 10 percent

Yellow perch:
- 1929–40:
  - Shallow trap nets, 73 percent
  - Small-mesh gill nets, 10 percent
- 1941–56:
  - Shallow trap nets, 80 percent
  - Fyke and hoop nets, 13 percent

White and redhorse suckers:
- 1929–40:
  - Shallow trap nets, 66 percent
  - Haul seines, 18 percent
- 1941–56:
  - Shallow trap nets, 69 percent
  - Haul seines, 18 percent
  - Fyke and hoop nets, 12 percent

Carp:
- 1929–40:
  - Haul seines, 77 percent
  - Shallow trap nets, 15 percent
- 1941–56:
  - Haul seines, 63 percent
  - Shallow trap nets, 22 percent
  - Large-mesh gill nets, 12 percent

Catfish:
- 1929–40:
  - Shallow trap nets, 60 percent
  - Haul seines, 29 percent
- 1941–56:
  - Shallow trap nets, 60 percent
  - Haul seines, 26 percent
  - Set hooks, 10 percent

INTERRELATION OF PRODUCTION, ABUNDANCE AND FISHING INTENSITY, 1929–56

The descriptions of fluctuations of production, abundance (table 6), and fishing intensity (table 7) are made with reference to average conditions in the period 1929–43, a 15-year period that has served as the normal in most studies of the modern State of Michigan fisheries. The records of catch per unit of effort from which estimates of abundance (availability) were made are given in the appendix, page 37.

Table 6.—Abundance of the principal commercial species of fish in Saginaw Bay, 1929–56

[Percentage of the 1929–43 mean]

Year	Lake trout [1]	White-fish [2]	Lake herring	Walleye	Yellow perch	White and redhorse suckers	Carp	Catfish
1929	88	192	32	49	105	127	43	109
1930	77	265	73	70	105	129	60	69
1931	97	284	75	45	94	87	88	52
1932	130	238	67	100	115	119	135	60
1933	170	111	59	116	68	104	103	67
1934	190	61	82	110	86	105	120	60
1935	101	73	69	105	123	71	138	63
1936	59	58	96	100	130	83	87	106
1937	88	67	113	109	65	87	102	107
1938	95	22	151	93	72	90	92	87
1939	71	13	195	104	91	87	98	85
1940	71	22	120	108	92	103	85	120
1941	92	19	129	110	86	102	105	166
1942	96	18	143	154	115	92	102	170
1943	75	57	96	127	153	114	142	179
1944	72	33	51	91	115	95	141	155
1945	32	55	49	64	79	98	231	158
1946	18	141	65	98	75	157	140	101
1947		363	59	51	86	152	174	136
1948		158	119	28	186	138	182	106
1949		34	146	18	152	122	170	117
1950		17	133	13	109	138	215	123
1951		37	107	15	102	178	281	139
1952		41	180	12	126	168	188	152
1953		30	157	16	121	183	230	192
1954		29	145	16	143	217	256	144
1955			52	17	173	210	254	197
1956			16	18	131	149	289	196

[1] Insufficient data or no production after 1946.
[2] Insufficient data for estimates in 1955 and 1956.

Table 7.—Fishing intensity for the principal commercial species of fish in Saginaw Bay, 1929–56

[Percentage of the 1929–43 mean]

Year	Lake trout [1]	White-fish [2]	Lake herring	Walleye	Yellow perch	White and redhorse suckers	Carp	Catfish
1929	156	92	155	97	79	94	113	118
1930	235	120	151	107	109	130	166	91
1931	229	210	152	114	131	137	119	46
1932	160	318	95	102	96	108	92	40
1933	100	210	100	93	92	102	115	50
1934	59	98	127	92	87	108	104	46
1935	41	89	129	93	128	112	93	67
1936	45	69	103	104	155	113	105	68
1937	74	71	92	105	101	106	116	82
1938	66	78	87	95	85	86	82	117
1939	86	61	90	108	91	85	80	104
1940	74	45	71	100	90	86	75	152
1941	67	18	62	99	72	81	75	177
1942	43	12	39	99	75	74	70	178
1943	65	9	47	92	109	78	95	164
1944	70	24	38	82	88	77	73	154
1945	31	18	54	66	84	83	115	183
1946	8	58	47	69	71	77	129	190
1947		112	38	54	55	61	76	151
1948		161	29	38	65	59	91	138
1949		72	29	32	55	51	62	109
1950		9	29	35	56	46	57	98
1951		15	27	33	57	51	63	124
1952		16	23	33	63	56	92	150
1953		6	20	32	61	53	62	128
1954		3	22	34	57	49	61	130
1955			16	26	53	42	62	137
1956			12	30	47	36	50	130

[1] Insufficient data or no production after 1946.
[2] Insufficient data for estimates in 1955 and 1956.

Brief comments on some characteristics of the Saginaw Bay fishery in relation to the assessment of fishing intensity may assist in the understanding of certain relations brought out in the following accounts for the principal species. On the whole, the fishery is "composite" in that several kinds of fish are customarily taken in the same lift of gear. This varied nature of the catch, together with our statistical procedure of assigning fishing effort on the basis of fishing experience rather than intent (a lift is charged to each species caught, regardless of poundage), results in the listing of considerable effort for a particular species at times when it is in fact an insignificant component of the take. Consequently, fishing pressure for a species does not vary closely with the availability of that species; rather it is influenced strongly by the conditions that determine the general level of operations. Rarely is the availability of a single species great enough that it could support operations alone; rather it is the return from the entire catch that determines the success of the enterprise. Thus it is that a fair amount of fishing may persist for a species that has declined to commercial unimportance (as the walleye), or, as a result of poor general economic conditions, intensity may decline in the face of rising abundance (as the lake herring, yellow perch, . . .).

The peculiar problem of estimating fishing pressure for individual species in a multispecies fishery seemingly has no fully satisfactory solution. We have considered numerous alternate approaches, but none has proved as satisfactory as the one we now employ. It is not to be concluded, however, that the composite nature of the fishery makes the separate estimation of fishing pressure for individual species meaningless. Different gears produce catches of different species composition and the seasonal distribution of the take differs widely among species (see immediately preceding sections). Furthermore, a species does not occur consistently in all lifts of a gear that may account for a good percentage of the total annual production of that species. Through selection of gear, grounds, and time of fishing, fishermen can and do exert considerable control over pressure on individual species.

Lake Trout

The statistics for lake trout through 1946, the last year for which estimates of abundance and fishing intensity were attempted, were reviewed by Hile (1949). Consequently only the briefest comments are required here. Production, abundance, and fishing intensity all reached their highest levels in the early years of the 1929–56 period (fig. 11). The 1929–43 mean was not once exceeded by production after 1934, by abundance after 1935, or by fishing intensity after 1933. The fishery continued at a low level in the late 1930's and early 1940's and collapsed completely in 1945 and 1946. Catches have been consistently below 500 pounds since 1948, and not one pound has been reported since 1952. The decline and disappearance of the lake trout fishery can be

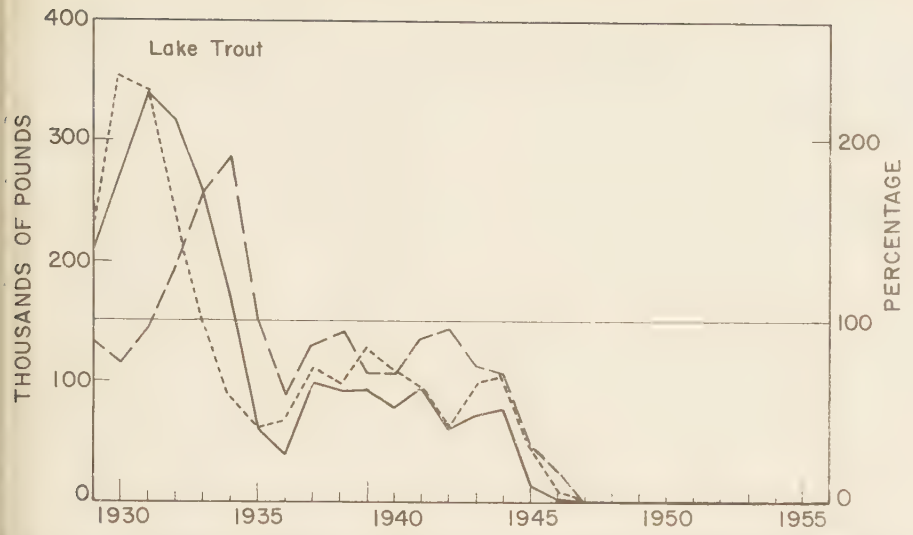


Figure 11.—Production (solid line), abundance (long dashes), and fishing intensity (short dashes) in the Saginaw Bay lake trout fishery. The scale in pounds applies to production only; the scale of percentage applies to all three variables and is in terms of the mean for 1929–43.

attributed to depredations of the sea lamprey.

Whitefish

Van Oosten, Hile, and Jobes (1946), who discussed the whitefish statistics through 1942, attributed the collapse of the fishery in the late 1930's and early 1940's to depletion resulting from excessive exploitation with deep trap nets in the early 1930's (fig. 12). Their evidence for this interpretation in the Saginaw Bay area and for other regions of central and southern Lake Huron was good.

The failure of the whitefish fishery to recover from depletion poses another problem. Despite consistently low fishing pressure—below average in 1934–46 and less than 50 percent of average in six of these years—the abundance of whitefish continued low through 1945. Sharp increases of abundance in 1946 and 1947 carried the index to the record high of 363 percent of average in the latter year. The decline from this peak was precipitous. Only 3 years later in 1950 the index was at 17 and in the 4 subsequent years it ranged between 29 and 41. Admittedly, these estimates of abundance at such trifling levels of production are most undependable, but the mere fact that production of this high-priced fish was so low proves that whitefish were too scarce to support profitable operations.

The whitefish that produced the high levels of abundance in 1946–48 were almost exclusively members of the phenomenally abundant year class of 1943 (unpublished records of age), a year that saw outstanding broods of whitefish and of other species in several areas (Hile 1950). Only the briefest comments can be offered as to why a recovery of the

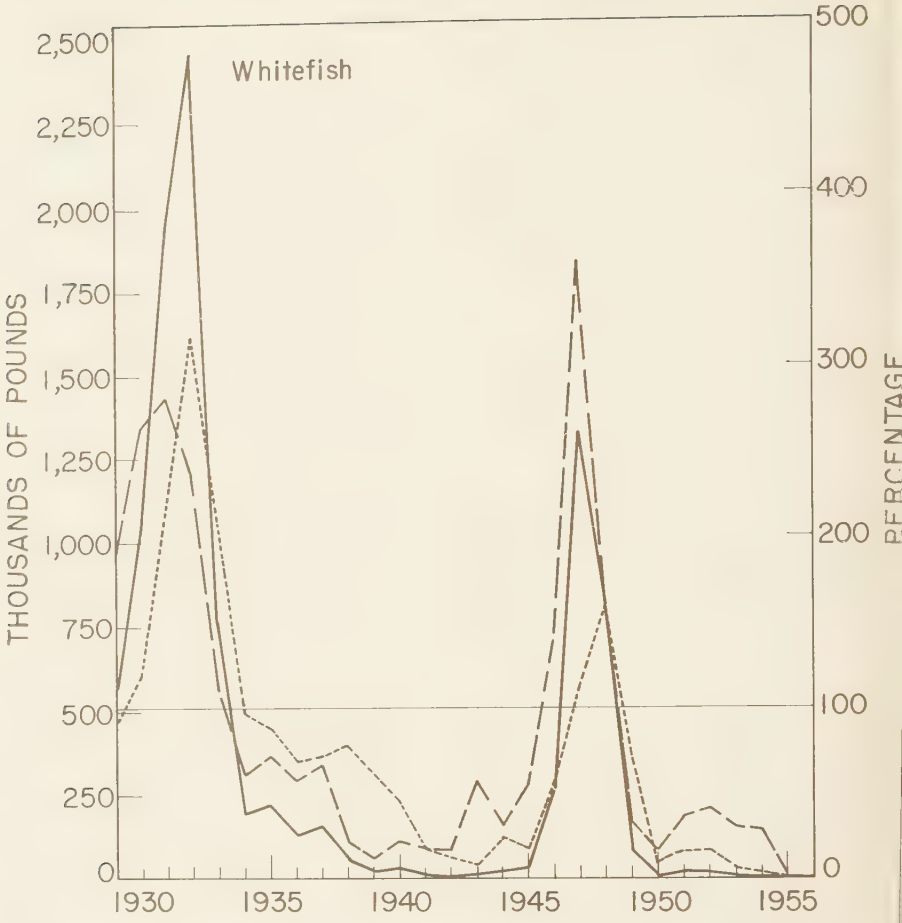


Figure 12.—Production (solid line), abundance (long dashes), and fishing intensity (sho dashes) in the Saginaw Bay whitefish fishery. The scale in pounds applies to productio only; the scale of percentage applies to all three variables and is in terms of the mean fo 1929–43.

stock did not occur earlier, why the year class disappeared so rapidly, and why so few progeny resulted from the large numbers of the year class. Indeed, we shall not comment at all on the first of these three points, but we firmly believe that sea lamprey depredations account for the high mortality rate in the 1943 year class and for the subsequent total failure of the fishery. The most-recent collapse cannot be attributed to depletion through overfishing. Fishing pressure wa above average in only 2 years (194 and 1948) and in neither did the in dex approach the levels of 1931–3

Lake Herring

Outstanding features of the sta tistics on lake herring have been th downward trend of fishing pressu since 1935 and the sharp drop i production after the peak of mo than 5½ million pounds in 1939 (fi 13). Production was consistentl

below the base-period mean after 1939 and did not exceed 50 percent of average after 1942. The abandonment of the pound-net fishery was a major factor in the sudden dropoff in the catch. Over the period 1929–40 this gear contributed from 1,340,000 pounds (1940) to 3,435,000 pounds (1931) to the herring production. The take of pound nets dropped to 378,000 pounds in 1941 and in no subsequent year did it reach 100,000 pounds. Catches of herring in trap nets and small-mesh gill nets increased as the pound-net fishery disappeared, but the rise was insufficient to compensate the loss of pound-net production.

High availability of lake herring has not stimulated fishing intensity. On the contrary, the years of most intensive fishing, 1929–36, were a period in which abundance was consistently below the 1929–43 average, and the major drop in fishing pressure came in years of high availability, 1937–42. The upward trend of abundance that started in 1948 and the high levels of 1949–54 did not bring about greater fishing intensity.

The significance of the sharp declines in catch and availability in 1955 and 1956 remains to be determined. Severe storms in November, the month of greatest production, badly disrupted fishery operations in both years. Consequently, the decline may not be as disastrous as the abundance indices suggest and an early recovery may be possible.

Walleye

Production and abundance of walleye were below average in 1929–31 (fig. 14), moved sharply upward, held reasonably steady at near- or above-average levels in 1932–43, dropped off rapidly in 1943–49, and were steady again but at extremely low levels in 1949–56. Fishing intensity fluctuated little from the 1929–43 average in that period of years, but a downward trend that was clearly apparent by

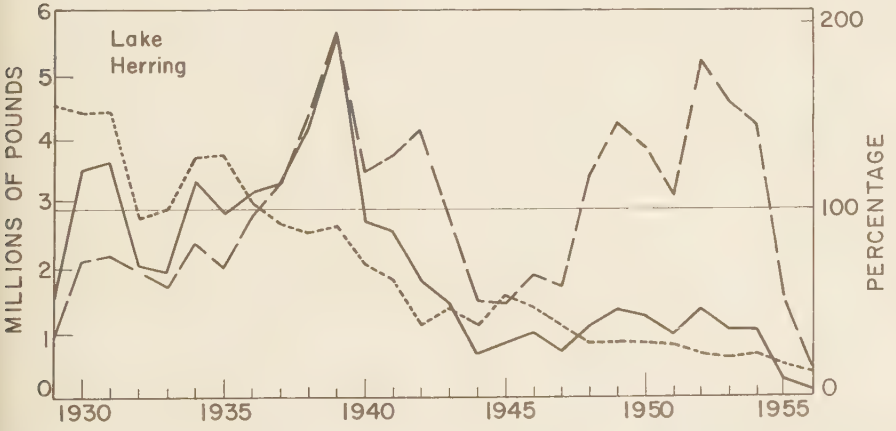


Figure 13.—Production (solid line), abundance (long dashes), and fishing intensity (short dashes) in the Saginaw Bay lake herring fishery. The scale in pounds applies to production only; the scale of percentage applies to all three variables and is in terms of the mean for 1929–43.

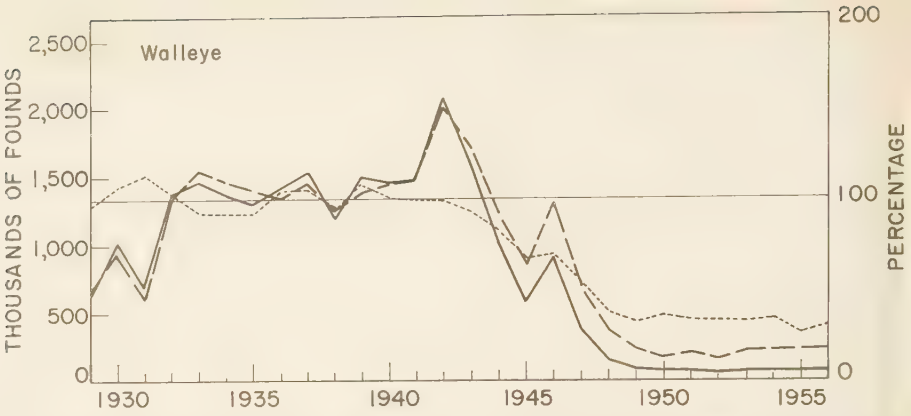


Figure 14.—Production (solid line), abundance (long dashes), and fishing intensity (shor dashes) in the Saginaw Bay walleye fishery. The scale in pounds applies to production only; the scale of percentage applies to all three variables and is in terms of the mean for 1929–43.

1944 carried the intensity to a new low level in 1949–56.

Most commercial fishermen of the Saginaw Bay area are convinced that the improvement in the abundance of walleyes in the early 1930's resulted from the start of fry plantings in the 1920's, that the good levels of 1931–43 were maintained by plantings, and that the collapse in the 1940's was caused by the abandonment of artificial propagation after 1944. It was pointed out, however, by Hile (1937) that other regions of Lakes Huron and Michigan exhibited similar increases of walleyes in the early 1930's even though they received inconsequential plantings or no plantings of fry and that the deep faith of fishermen in fry planting was based on a misconception as to the number of years between planting and the time when benefits possibly could result. He concluded that evidence was lacking for any benefits from stocking. Data for years subsequent to those covered by Hile's report have given no cause to change that conclusion.[2]

A thorough consideration of factors that might have brought about the decrease of walleyes has led us to believe that sea lamprey depredation was the most important factor. Support for this hypothesis can be drawn from the evidence on the summer-autumn distribution of walleyes in relation to known seasonal movements of parasitic-phase sea lampreys and from the similarity in the timing of the failure of the walleye and lake trout fisheries.

The seasonal records of production (see earlier section) prove that few walleyes are taken in the fishery after June. True, fishing activities are light during the third quarter but intensity is great in the fall. The evidence suggests, therefore, that most of the walleyes spend the last half of the year outside Saginaw Bay proper. This view is supported by the counts of walleyes in pound

[2] See Dymond (1957) for a recent discussion of artificial propagation in the management of the Great Lakes fisheries.

nets and deep trap nets fished out of the ports of Oscoda, East Tawas, and Bay Port (Van Oosten, Hile, and Jobes, 1946). Most or all of these nets were lifted outside the Bay proper but most were within the "Saginaw Bay area" as covered by this report. Nearly all of them fished in more than 60 feet of water were deep trap nets. The records of catch per net by month and by 10-foot interval of depth proved that both small (less than 1½ pounds) and large walleyes moved offshore during the summer and early fall. A lesser percentage of small than of large walleyes moved into the greater depths and not one small walleye was seen in nets lifted from deeper than 20 fathoms. Larger walleyes moved offshore in relatively greater numbers and some were caught beyond 20 fathoms in July, August, and September. Thus we have evidence that walleyes move well out into the deeper water in late summer at a time when parasitic-phase sea lampreys are moving toward shore (Applegate 1950). The probability of opportunity for extensive lamprey predation is accordingly strong. Unfortunately, we do not have sufficient observations on the incidence of scarring that might offer a clue as to the actual severity of the predation.

Further evidence that the sea lamprey may have contributed significantly to the decline of the walleyes comes from the similarity in the timing of the collapse of the walleye fishery, and of the fishery for the lake trout, a species that surely was destroyed by lampreys (Hile 1949; Hile, Eschmeyer, and Lunger, 1951; Fry 1953). A comparison of the abundance percentages for the two species in 1942 and subsequent years follows:

Year:	*Lake trout*	*Walleye*
1942	96	154
1943	75	127
1944	72	91
1945	32	64
1946	18	98
1947	------	51
1948	------	28

Both species experienced a rapid decline after 1942; the principal difference was the temporary recovery of walleye in 1946. This rise was followed, however, by a new decline to 28 percent in 1948.

The recovery of walleyes in 1946 can be attributed to the great strength of the 1943 year class (unpublished records of age). Rich as the year class was, its effects were short lived. The 1943 year class failed in Saginaw Bay to support the sustained good fishing over a period of years such as the same year class produced in Green Bay, Lake Michigan (Hile, Lunger, and Buettner, 1953). It is concluded, therefore, that but for an exceptionally good hatch in 1943, the declines of lake trout and walleye in the Saginaw Bay area would have been closely similar.

Yellow Perch

For about 20 years, the yellow perch, like the lake herring, has been exploited at a decreasing rate in the face of a generally rising abundance. Fluctuations in catch, abundance, and fishing intensity were somewhat erratic in the earlier years of the 1929–56 period, but

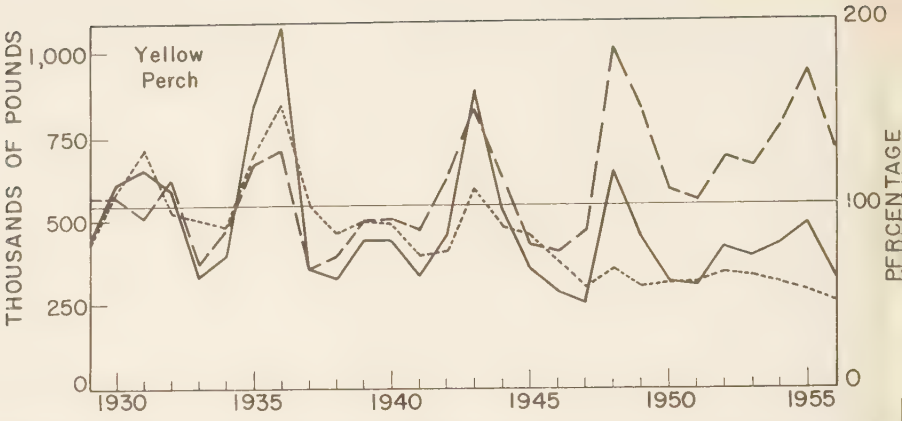


Figure 15.—Production (solid line), abundance (long dashes), and fishing intensity (sho dashes) in the Saginaw Bay yellow perch fishery. The scale in pounds applies to productio only; the scale of percentage applies to all three variables and is in terms of the mean f 1929–43.

toward the late 1930's trends began to develop (fig. 15). After dropping to the 28-year low of 65 in 1937, the abundance index started on a cyclic upward trend. It climbed irregularly to a value of 153 in 1943, dropped to below-average values in 1945–47, jumped suddenly to the 28-year high of 186 in 1948, and remained above the 15-year base in all subsequent years (lowest, 102 in 1951; highest, 173 in 1955).

Fishing pressure started its period of generally low values in 1938. The intensity index exceeded the 1929–43 mean only once in subsequent years (109 in 1943), and after 1943 the trend was rather consistently downward. The 1956 index of only 47 was a 28-year low.

The downtrend of fishing pressure has, in the main, outweighed the uptrend of abundance so that production has been below the 1929–43 base every year but two since the peak yield of 1,074,000 pounds (197 percent of the 15-year average) in 1936. The exceptions have been 1943 (catch, 883,000 pounds) an 1948 (640,000 pounds). Lowes production of the 1929–56 perio was 251,000 pounds in 1947.

El-Zarka (1959) demonstrate that the indices of availability hav failed to measure fully the increa in the numbers of yellow perch Saginaw Bay. Through the app cation of sample data on length a weight (1943–55, his sample 1929–30, samples of Hile and Jobe 1941) to records of catch per u effort of shallow trap nets he es mated that the numbers of perch a size that could be retained by t nets had increased about sevenfo from the earlier period to the lat Growth rate had decreased so mu between the sampling periods, ho ever, that relatively few of the f in the 1943–55 samples were of le size (8½ inches). He concluded th the stock was overcrowded throu underexploitation and recomme ed a relaxation of restrictions the taking of perch.

White and Redhorse Suckers

The suckers (mostly white suckers in Saginaw Bay) provide a third example of a generally low production in recent decades and a declining fishing pressure in the face of rising abundance. The availability of suckers varied widely but with little or no trend in 1929–45, but after 1945 the abundance index did not fall below 122 (the value for 1949) and exceeded 200 in 1954 and 1955 (fig. 16). The general trend since 1945 has been strongly upward despite possible underestimates for recent years. The market for suckers has become so poor that at some times only part of the catch has been landed and reported.

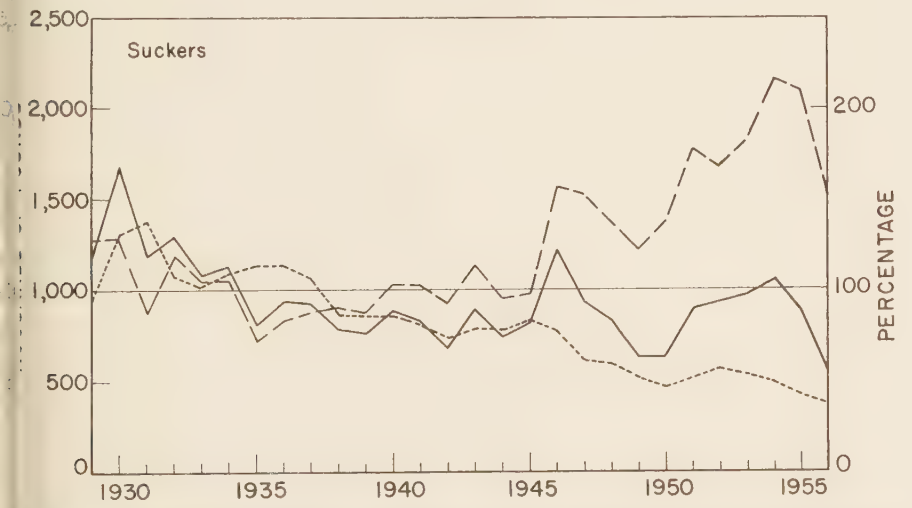
Fishing intensity for white and redhorse suckers was highest in the earlier years of the 1929–56 period (index continually above 100 in 1930–37). The level of fishing pressure has not once reached the 1929–43 mean index of 100 since 1937, and the trend has been decidedly downward since 1945. The intensity index was less than 50 percent in 1950 and 1954–56 (only 36 in 1956).

The rising abundance counteracted the declining fishing pressure sufficiently that production, though generally low—above the 1929–43 average only twice (1946 and 1954) since 1934—has not exhibited a clear downward trend. The lowest level of the period was reached, however, in 1956 (only 536,000 pounds).

Carp

The upward trend in the abundance of carp since the early 1940's has been so great that production has been continuously above the 1929–43 average since 1942 despite levels of fishing intensity that were below average in most of the more recent years (fig. 17).

The availability of carp was very



gure 16.—Production (solid line), abundance (long dashes), and fishing intensity (short dashes) in the Saginaw Bay white and redhorse sucker fishery. The scale in pounds applies to production only; the scale of percentage applies to all three variables and is in terms of the mean for 1929–43.

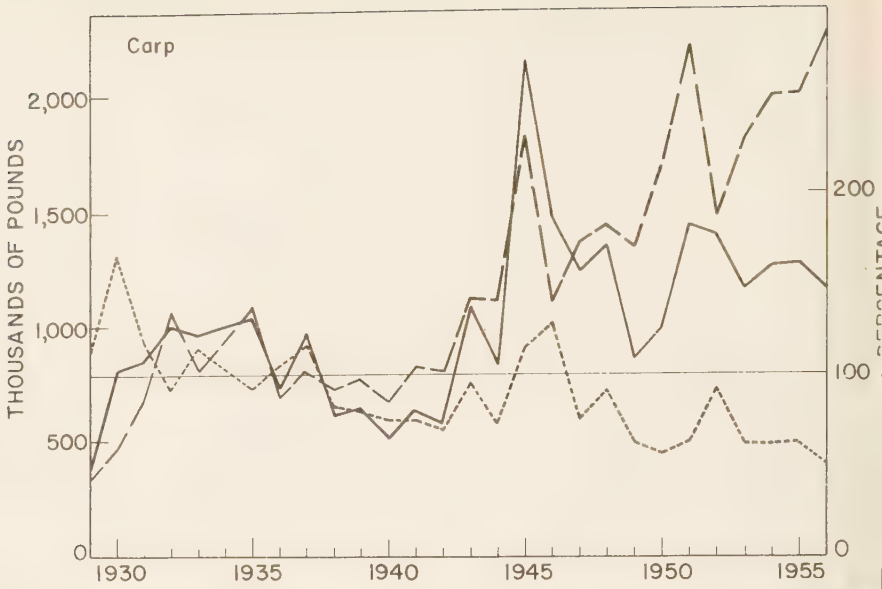


Figure 17.—Production (solid line), abundance (long dashes), and fishing intensity (sh dashes) in the Saginaw Bay carp fishery. The scale in pounds applies to production on the scale of percentage applies to all three variables and is in terms of the mean for 1929–

low in 1929 and 1930 (abundance indices of 43 and 60), but in 1931–42 the variations were mostly limited and without distinct trend. In 1943, however, an upward trend started that was to carry abundance to extraordinarily high levels. Availability exceeded twice the 1929–43 mean in 1945, 1950–51, and 1953–56. The peak index of 289 was reached in 1956.

Fishing intensity was generally high in the earlier years of the 1929–56 period (below the 1929–43 mean only twice in 1929–37). The intensity index was below 100 in 1938–44, but it exceeded that figure in 1945 and 1946. Since the latter year, the trend has been irregularly but clearly downward. In 1956 the index was only half the base-period mean.

Production has been continually above the 1929–43 average since 1942 despite below-average fish pressure in every year but 1945 a 1946. The combination of intens fishing and high abundance led extremely high catches in th years (2,145,000 pounds in 1945 a 1,462,000 in 1946). Subsequen the yield has exhibited no cl trend.

Catfish

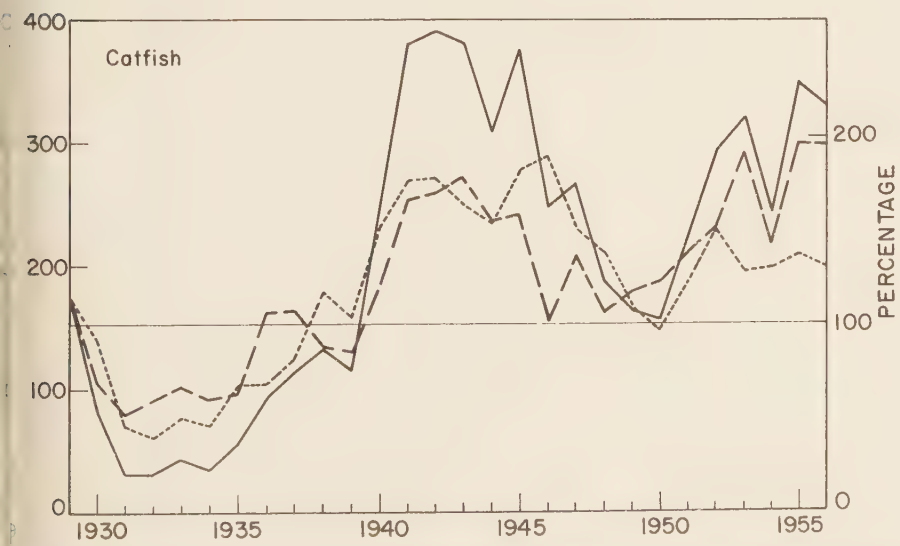
The catfish is the only Sagi Bay species for which producti availability, and fishing press have been consistently above 1929–43 average over many ye All have exceeded the 15-year m each year since 1939 with the si exception of an intensity index o in 1950 (fig. 18). The catfish fis has borne up in recent years bec the species has been the only that remained in relatively g supply and at the same time

yed a steady market at good rices.

Catfish were scarce in most of the arlier years of the 1929–1956 pe- od. In 1929–39, the abundance dex exceeded 100 only three times. 1 1940, however, the index rose harply to 120 and it has subse- uently continued above the 929–43 mean. The fluctuations of vailability for the entire 28 years fer a suggestion of periodic varia- on with a general upward trend. rom an above-average value in 929 the abundance dropped to the vel of the poor years of 1930–35, imbed irregularly to the high alues of 1941–45 (indices all reater than 150), fell to the lower ut still above-average) figures of 946-51, and then climbed irregu- rly to the record high index of 197 1 1955 (nearly as high—196—in 956).

The trends of fishing intensity have been closely similar to those of abundance. Intensity usually has been high in periods of high availability and low in years of scarcity. An indication that fishing pressure may start on a decline despite high abundance is offered by the failure of the fishing-intensity index to increase as rapidly as the abundance index in the most recent years.

Except for 1929, production of catfish was consistently below the 1929–43 mean until 1940. Substantial increases of availability and fishing intensity carried the yield to the high level of 1941–45 (catch more than twice the 15-year mean in all 5 years; more than 2½ times in 3 of them). The take again exceeded twice the average in 1953, 1955, and 1956, but the production in these years did not reach the values of 1941–43 and 1945.



gure 18.—Production (solid line), abundance (long dashes), and fishing intensity (short dashes) in the Saginaw Bay catfish fishery. The scale in pounds applies to production only; the scale of percentage applies to all three variables and is in terms of the mean for 1929–43.

OUTLOOK FOR SAGINAW BAY FISHERIES

To describe the commercial fishery of Saginaw Bay as threatened by failure would be unduly optimistic, for it is now collapsing and the process is well-advanced. The greatly decreased fishing activities would be much lower except that many fishermen resist abandonment of a lifetime occupation or are protecting capital investment in the hope of better days. This "hanging-on" cannot continue much longer.

Detailed comments on the complex and varied economic problems of the fisheries are outside our competence, but certain important points are obvious. Saginaw Bay fisheries like other segments of the industry have been caught in the "squeeze" created by a rise in cost of production much greater than the increase in the price of fish. Limitations of capital, the small size of producing firms, the division of the fishery among numerous ports of landing, legal restrictions on grounds, methods, and time of fishing, and the resistance to change that these conditions encourage, have made most difficult the adjustments that might have eased the stringency. The Saginaw Bay fishermen, in the main, are taking and handling fish in the same way as for several decades past. Some advances have been made in fishing, processing, and marketing, but they have been limited.

The distress of the industry has been aggravated by changes in the species composition of the exploitable stock. The species that traditionally have brought the best prices and have had the steadies market have dwindled to unimpo tance. Lake trout had all but di appeared by the midforties; whit fish, except for a brief outburst i 1946–48, has been scarce and pr duced only in small quantities sin the midthirties; walleye abundan has been low and production has n exceeded 100,000 pounds since 194 Of the remaining principal speci there has been no scarcity, but t difficulty of producing most of the at a profit has restricted their e ploitation over the last 10 to years. Only the catfish brings good price on a reasonably stea market and it is for this speci alone that the rate of exploitati and production both have tended rise.

Lake herring, yellow perch, wh and redhorse suckers, and ca despite generally above-average a sometimes extremely high levels abundance, have been subject low fishing pressure. Producti has been extremely low for la herring and perch despite good l els of availability. (The signi cance of the poor fishing for la herring in 1955 and 1956 remains be determined—see preceding s tion.) The take of suckers has mained at a relatively good le only because of a considerable r in availability. The increase abundance of carp has been so gr (abundance in excess of 2½ tin that of the 1929–43 base period some years) that the trend of p duction has been upward desp low fishing pressure. In short, have had relatively high availabil

of five of eight principal species, but the fishery has been so unprofitable that operations have declined.

We can hardly hope for a prosperous fishery in the Saginaw Bay area unless a good level of abundance is established for some of the high-priced species that are now so scarce. Most helpful would be the restoration of the walleye, long the principal "money fish" of the industry. In view of the evidence, however, that sea lampreys surely destroyed the lake trout, were a major factor in the decline of whitefish, and very probably contributed heavily to the decrease of the walleye, it follows that future prosperity is contingent on the establishment of effective control of the lamprey and the institution of appropriate measures for the restoration of the damaged stocks of fish.

Excellent progress has been made in the development of methods for controlling sea lampreys and in the application of those methods (Applegate and Moffett, 1955; Applegate et al., 1957; Erkkila, Smith, and McLain, 1956; and others) but the reduction of the parasite and the restoration of the fishery will require years—how many we cannot predict at this time. In the meantime we face the problem of preserving as much as is possible of the presently reduced fishery. Possible lines of action are few and the outlook is poor. Some improvements in the status of fishermen may be accomplished from increased processing and better handling and from market development. Some help may be possible from changes of fishing regulations. At its 1957 session, the State of Michigan Legislature eliminated the closed season on yellow perch, placed the black crappie on the list of commercial species, and opened certain grounds previously closed to commercial operations. Other relaxations of restrictions can be expected. Benefits from changes of regulations will, nevertheless, be limited and the situation of the fishery must in honesty be termed precarious.

LITERATURE CITED

Applegate, Vernon C.

1950. Natural history of the sea lamprey, *Petromyzon marinus*, in Michigan. U. S. Fish and Wildlife Service, Spec. Sci. Rept.: Fish. No. 55, 237 pp.

Applegate, Vernon C., and James W. Moffett.

1955. The sea lamprey. Sci. American, vol. 192, No. 4, pp. 36–41.

Applegate, Vernon C., John H. Howell, A. E. Hall, jr., and Manning A. Smith.

1957. Toxicity of 4,346 chemicals to larval lampreys and fishes. U. S. Fish and Wildlife Service, Spec. Sci. Rept.: Fish. No. 207, 157 pp.

Dymond, J. R.

1957. Artificial propagation in the management of Great Lakes fisheries. Trans. Am. Fish. Soc., vol. 86 (1956), pp. 384–392.

El-Zarka, Salah El-Din.

1959. Fluctuations in the population of yellow perch, *Perca flavescens* (Mitchill), in Saginaw Bay, Lake Huron. U. S. Fish and Wildlife Service, Fish. Bull., vol. 58, No. 151, pp. 365–415.

Erkkila, Leo F., Bernard R. Smith, and Alberton L. McLain.
1956. Sea lamprey control on the Great Lakes, 1953 and 1954. U. S. Fish and Wildlife Service, Spec. Sci. Rept.: Fish. No. 175, 27 pp.

Fry, F. E. J.
1953. The 1944 year class of lake trout in South Bay, Lake Huron. Trans. Am. Fish. Soc., vol. 82 (1952), pp. 178–192.

Gallagher, Hubert R., and John Van Oosten.
1943. Supplemental report of the United States members of the International Board of Inquiry for the Great Lakes fisheries. Internat. Bd. Inquiry for the Great Lakes Fish.—Rept. and Suppl., pp. 25–213.

Hile, Ralph.
1937. The increase in the abundance of the yellow pike-perch, *Stizostedion vitreum* (Mitchill), in Lakes Huron and Michigan, in relation to the artificial propagation of the species. Trans. Am. Fish. Soc., vol. 66 (1936), pp. 143–159.
1949. Trends in the lake trout fishery of Lake Huron through 1946. Trans. Am. Fish. Soc., vol. 76 (1946), pp. 121–147.
1950. Green Bay walleyes—a report on the scientific investigation of the marked increase in abundance of walleyes in Green Bay. The Fisherman, vol. 18, No. 3, pp. 5–6.
1954. Fluctuations in growth and year-class strength of the walleye in Saginaw Bay. U. S. Fish and Wildlife Service, Fish. Bull., vol. 56, No. 91, pp. 7–59.

Hile, Ralph, and Frank W. Jobes.
1941. Age, growth, and production of the yellow perch, *Perca flavescens* (Mitchill), of Saginaw Bay. Trans. Am. Fish. Soc., vol. 70 (1940), pp. 102–122.

Hile, Ralph, Paul H. Eschmeyer, and George F. Lunger.
1951. Decline of the lake trout fishery in Lake Michigan. U. S. Fish and Wildlife Service, Fish. Bull., vol. 52, No. 60, pp. 77–95.

Hile, Ralph, George F. Lunger, and Howard J. Buettner.
1953. Fluctuations in the fisheries of State of Michigan waters of Green Bay. U. S. Fish and Wildlife Service, Fish. Bull., vol. 54, No. 75, pp. 1–34.

Smith, Hugh M., and Merwin-Marie Snell.
1891. Review of the fisheries of the Great Lakes in 1885, with introduction and description of fishing vessels and boats by J. W. Collins. Rept. U. S. Comm. Fish. for 1887, pp. 1–333.

Van Oosten, John, Ralph Hile, and Frank W. Jobes.
1946. The whitefish fishery of Lakes Huron and Michigan with special reference to the deep-trap-net fishery. U. S. Fish and Wildlife Service, Fish. Bull., vol. 50, No. 40, pp. 297–394.

APPENDIX

Appendix Table 1.—Catch (thousands of pounds) of fish combined in text table 1 under the heading "Other"

[Where no catch is indicated none was reported; for comments on questionable identity of certain entries, see section on Sources of Statistics, p. 2]

Year	Round whitefish	Chubs	Smelt	Sauger	Longnose sucker	Bullheads	Sheepshead	Burbot	Rock bass	Northern pike	Sturgeon	Black bass	White bass	Bowfin	Buffalo	Gizzard shad	Mooneye	Sea lamprey	Miscellaneous
1885						[1] 808					81	152							4,088
1891											54	36							70
1892				4							42	15							150
1893											26	41							173
1894				4							10	12							280
1895				[2]							8	6							185
1896				[2]							10	44							179
1897				1							9	14							277
1898				[2]							7	41							227
1899									74		7	1							340
1900									121		8	1							214
1901											7	9							384
1902				[2]					124		8	2							209
1903									163		7	1							309
1904									83		8	1							268
1905									63		4	[2]							674
1906									52		3	1							616
1907				1					69		2	1							574
1908				4					[2]		2	[2]							273
1916	9										[2]								684
1917											1								37
1918	1										2								73
1919	8	32				25	12	10	7	24	2				1				
1920	2	[2]				20	10	5	2	16	2								
1921						6	9	[2]	1	22	2				3				
1922	2			18		10	18	[2]		10	[2]								
1923	1					2	32	8		31	[2]								
1924	5					35	34	4		25	6				2				
1925	10	51				9	35	5		9	2				3				
1926	6			28			52	1		6	1				8				
1927	10			25		[2]	34	3		24	1			[2]	2				
1928	3	76		42		6	10	2		9				2					
1929	[2]	[2]		33	26	15	7	1	6	40				23					
1930	[2]	[2]		204	7	52	2	3	12	49				16					
1931	1			198	36	78	1	3	13	13				3					
1932	1	[2]		65	29	37	[2]	1	4	3				3					
1933	2			80	40	14	[2]	1	10	6			[2]	[2]					
1934	3			64	48	10	[2]	[2]	11	1			[2]	3					
1935	1	[2]		169	29	13	2	1	16	2				1					
1936	4	[2]		36	15	21	2	[2]	9	12				[2]					

1938	3			1	6	26	1	(2)	22	11				1		(2)				
1939	10	(2)		1	1	29	(2)	(2)	10	4				3		(2)				
1940	1	(2)		1	5	27	1	(2)	9	(2)				3		(2)				
1941	2		1	(2)	5	39	(2)	(2)	8					2		(2)				
1942	3	(2)	1	2	4	44	(2)	(2)	15				(2)	1						
1943	1	(2)	(2)	3	6	39	1	(2)	20				(2)	6		(2)				
1944	2	(2)		2	7	41	1	1	19					9		(2)				
1945	(2)	(2)	2	3	13	63	(2)	(2)	24				(2)	16		(2)				
1946	1	2	3	4	9	64	(2)	4	15				(2)	8		(2)		(2)		
1947	6	(2)	2	2	8	66	(2)	(2)	10	4				9		(2)				
1948	1	(2)	(2)	(2)	6	54	(2)	(2)	15	46			(2)	10						
1949	(2)		(2)	(2)	2	18	(2)	1	10	13				8		1	(2)			
1950	(2)		112	(2)	(2)	9	(2)	(2)	10	6			(2)	5		(2)				
1951	1		218	(2)		6	(2)	(2)	8	6			(2)	7		(2)	(2)			
1952	(2)		194	1		9	(2)	(2)	11	22	(2)			19		1				
1953	(2)	5	146	1	1	29	(2)	(2)	19	32	(2)		3	16		(2)				
1954	(2)	9	143	(2)	3	37	(2)	(2)	25	22	(2)		6	11		1				
1955		7	138	(2)	5	60	(2)		30	32	(2)		2	10		1				
1956	(2)		192	1	(2)	46	12		27	19	(2)		3	6		4	(2)			

[1] Although listed as bullheads, almost certainly included catfish.
[2] Less than 500 pounds.

Appendix Table 2.—Percentage species composition of the commercial catch in the Saginaw Bay fisheries, 1885–1956

Year	Lake trout	White-fish	Lake herring	Walleye	Yellow perch	Suckers	Carp	Catfish	Other
1885	7.8	2.2	13.4	8.9	----	----	----	----	67
1891	2.5	1.4	36.2	24.3	17.2	14.1	----	1.9	2
1892	2.5	2.3	24.7	15.2	26.4	24.1	----	1.7	3
1893	2.3	2.5	36.6	8.4	20.8	25.3	----	1.2	2
1894	0.9	1.1	30.1	18.2	19.5	26.1	----	1.2	2
1895	0.7	2.1	35.5	8.9	17.7	32.0	----	1.1	2
1896	0.9	2.6	57.8	7.2	15.6	12.0	----	1.5	2
1897	0.9	3.1	46.3	13.1	16.5	14.4	----	2.5	3
1898	1.0	2.5	47.2	12.3	21.7	10.5	----	2.1	2
1899	0.5	3.0	38.5	11.5	27.7	10.3	----	4.3	4
1900	0.4	1.9	37.7	7.7	33.4	13.0	----	2.6	3
1901	0.2	2.1	50.2	5.7	26.8	10.8	----	1.1	3
1902	0.4	2.3	59.9	7.1	16.8	10.0	----	1.1	2
1903	0.5	3.8	43.6	15.2	17.8	14.0	----	1.0	4
1904	0.4	2.7	52.2	14.7	13.6	12.4	----	0.7	3
1905	0.6	2.1	36.6	14.1	15.6	23.0	----	0.7	3
1906	0.7	2.1	28.1	11.0	18.3	31.5	----	1.2	4
1907	0.8	2.6	38.2	9.0	17.7	25.2	----	0.6	4
1908	0.7	3.3	58.6	9.8	13.2	10.2	----	0.8	2
1916	0.5	11.4	50.3	6.2	15.5	9.6	----	----	6
1917	0.8	4.0	53.8	19.1	12.3	9.3	----	----	1
1918	0.5	1.6	48.3	22.6	9.9	8.1	8.0	----	1
1919	1.5	2.0	43.8	14.1	11.5	12.8	12.5	0.4	1
1920	0.2	3.2	39.0	12.1	12.8	18.6	13.0	0.2	1
1921	0.3	4.8	28.3	11.6	14.0	21.8	18.0	0.3	1
1922	0.2	4.4	41.5	15.2	6.4	16.8	14.3	0.4	1
1923	0.2	5.0	42.1	14.3	13.2	16.2	6.8	0.4	1
1924	0.2	5.9	46.1	8.4	12.0	11.0	12.6	0.8	1
1925	1.9	4.1	61.8	5.6	6.9	10.0	6.6	1.0	1
1926	1.6	7.9	53.0	9.4	5.4	13.6	5.6	1.9	1
1927	0.6	5.8	44.2	6.9	1.2	17.4	20.9	1.9	1
1928	0.5	7.3	22.8	19.5	5.9	26.5	7.9	5.0	4
1929	3.8	10.8	29.5	11.9	8.3	22.5	7.3	3.1	3
1930	2.8	11.1	37.7	10.7	6.5	18.0	8.6	0.9	4
1931	3.4	20.1	37.8	7.0	6.8	12.2	8.8	0.3	3
1932	3.3	26.7	22.1	14.9	6.4	14.0	10.8	0.3	2
1933	3.6	11.0	27.5	21.0	4.8	15.4	13.9	0.6	2
1934	2.1	2.5	43.2	17.3	5.1	14.6	12.9	0.5	2
1935	0.8	2.9	38.6	17.6	11.4	10.9	14.0	0.7	2
1936	0.5	1.7	41.3	18.3	14.0	12.2	9.5	1.2	1
1937	1.3	2.1	44.1	20.4	4.7	12.3	12.8	1.5	1
1938	1.2	0.8	56.4	15.8	4.4	10.5	8.2	1.8	1
1939	1.0	0.3	60.8	16.2	4.8	8.1	6.9	1.2	1
1940	1.2	0.5	42.5	22.6	6.9	13.8	8.0	3.7	1
1941	1.4	0.2	40.3	23.1	5.2	12.9	10.0	6.0	1
1942	1.0	0.1	29.4	33.6	7.6	11.2	9.5	6.4	1
1943	1.1	0.2	22.6	24.3	13.8	13.9	16.9	6.0	1
1944	1.8	0.6	14.9	23.4	12.7	17.5	19.7	7.4	2
1945	0.3	0.6	16.0	10.7	6.7	15.5	40.8	7.1	2
1946	[1] 0.0	4.8	18.0	16.6	5.1	22.2	26.7	4.6	2
1947	[1] 0.0	25.5	13.7	7.1	4.8	17.9	23.7	5.2	2
1948	[1] 0.0	15.9	21.4	2.7	12.3	15.7	25.8	3.6	2
1949	[1] 0.0	2.2	36.9	2.1	12.2	17.2	23.5	4.5	1
1950	[1] 0.0	0.1	34.5	1.8	9.1	18.2	27.8	4.4	2
1951	0.0	0.4	22.3	1.6	7.5	21.9	34.9	5.4	2
1952	[1] 0.0	0.4	28.2	1.2	8.9	20.0	29.6	6.3	3
1953	0.0	0.1	24.1	1.6	9.5	23.3	27.7	7.7	2
1954	0.0	0.1	23.3	1.6	10.0	24.4	29.1	5.6	2
1955	0.0	[1] 0.0	7.2	1.7	13.6	24.7	35.4	9.7	2
1956	0.0	[1] 0.0	2.2	2.5	11.8	19.1	41.6	11.8	2

[1] Less than 0.05.

Appendix Table 3.—Catch (pounds) per unit of fishing effort for eight principal species in the commercial fisheries of Saginaw Bay

[Units of effort: gill nets—lift of 10,000 linear feet; pound nets, trap nets, and fyke and hoop nets—lift of 1 net; seines—haul of a 100-rod seine; set hooks—lift of 1,000 hooks. When no value is given the take of the gear was nil or too limited to provide a useful estimate; no estimate made for lake trout after 1946 or for whitefish after 1954]

A. LAKE TROUT

Year	Large-mesh gill nets	Set hooks
29	122	185
30	112	169
31	147	148
32	202	231
33	277	69
34	310	91
35	214	88
36	[1] 832	71
37	140	89
38	157	70
39	114	69
40	115	37
41	144	160
42	152	
43	119	59
44	114	
45	50	
46	28	

[1] Based exclusively on the catch of nets set on reef in November; figures not used in estimates of abundance.

B. WHITEFISH

Year	Large-mesh gill nets	Pound nets	Deep trap nets
29	72	33	
30	82	58	127
31	69	40	470
32	64	35	341
33	14	14	168
34	40	10	87
35	4	11	108
36		8	87
37	6	5	111
38	4	5	30
39	6	2	18
40	3	5	29
41	3	3	28
42	12	1	24
43	8	1	91
44	28		41
45	16		77
46	71		191
47	124	82	504
48	86		220
49			48
50			23
51			51
52			57
53			42
54			41

C. LAKE HERRING

Year	Pound nets	Shallow trap nets
1929	94	14
1930	222	23
1931	231	18
1932	201	26
1933	176	28
1934	240	86
1935	244	43
1936	316	70
1937	397	84
1938	604	101
1939	601	182
1940	426	96
1941	205	154
1942	194	150
1943	138	94
1944		49
1945	38	47
1946	254	61
1947	199	56
1948	365	113
1949	266	143
1950	381	126
1951		102
1952		171
1953		149
1954	58	141
1955	142	49
1956		15

D. WALLEYE

Year	Large-mesh gill nets [2]	Pound nets	Shallow trap nets	Haul seines
1929	255	18	15	25
1930	406	18	26	74
1931	140	13	21	16
1932	572	22	46	43
1933	592	27	52	80
1934	499	29	47	79
1935	536	12	49	86
1936	391	17	43	140
1937	249	13	52	77
1938	299	14	40	140
1939	432	13	46	106
1940	304	16	49	82
1941	380	11	49	110
1942	556	7	67	190
1943	380	11	55	134
1944	247	13	38	164
1945		18	26	73
1946		31	37	147
1947		14	18	112
1948	212	10	9	78
1949			8	20
1950			6	25
1951			6	28
1952			5	32
1953			7	12
1954	168		7	9
1955	190		7	86
1956			8	15

[2] April only; see Hile (1937).

Appendix Table 3.—Catch (pounds) per unit of fishing effort for eight principal species in t commercial fisheries of Saginaw Bay—Continued

E. YELLOW PERCH

Year	Small-mesh gill nets	Pound nets	Shallow trap nets	Fyke and hoop nets	Haul seines
1929	457	6	18	6	30
1930	146	7	18	10	22
1931	97	7	17	11	22
1932	156	7	19	12	20
1933	87	3	12	7	15
1934	78	4	15	6	27
1935	122	4	24	12	52
1936	157	5	26	7	42
1937	50	3	11	9	44
1938	38	4	12	7	34
1939	54	5	15	8	44
1940	110	8	15	10	25
1941	55	10	13	12	38
1942	196	15	17	18	35
1943	262	100	23	20	57
1944	127	8	18	17	39
1945	----------	18	12	11	26
1946	----------	13	12	8	15
1947	----------	19	13	11	18
1948	114	32	31	19	48
1949	111	33	24	19	21
1950	65	26	18	15	36
1951	88	----------	17	11	15
1952	91	43	21	13	13
1953	205	15	19	14	27
1954	227	18	23	17	28
1955	217	----------	28	24	68
1956	222	7	22	11	29

F. WHITE AND REDHORSE SUCKERS

Year	Pound nets	Shallow trap nets	Fyke and hoop nets	Haul seines
1929	13	33	9	304
1930	15	32	17	237
1931	13	25	13	106
1932	14	36	20	127
1933	6	33	17	126
1934	7	34	16	100
1935	7	20	16	111
1936	9	24	17	102
1937	7	24	23	118
1938	6	27	17	92
1939	5	25	15	125
1940	8	28	16	218
1941	8	28	17	193
1942	15	22	18	276
1943	10	25	18	449
1944	----------	20	14	383
1945	----------	21	22	272
1946	16	36	20	408
1947	----------	36	32	382
1948	----------	34	42	226
1949	----------	33	31	153
1950	----------	36	31	319
1951	----------	47	41	276
1952	----------	45	34	282
1953	----------	43	42	620
1954	----------	56	62	309
1955	----------	52	101	299
1956	63	38	70	364

G. CARP

Year	Shallow trap nets	Haul seines
1929	8	1
1930	10	2
1931	7	3
1932	7	6
1933	12	4
1934	9	5
1935	8	6
1936	5	3
1937	7	4
1938	8	3
1939	7	4
1940	7	3
1941	9	4
1942	12	3
1943	14	5
1944	12	6
1945	15	1, 0
1946	18	1
1947	18	*
1948	16	*
1949	16	*
1950	13	1, 0
1951	17	1, 3
1952	19	*
1953	18	1, 0
1954	16	1,
1955	27	
1956	18	1,

H. CATFISH

Year	Shallow trap nets	Haul seines	Set hook
1929	9	81	
1930	5	58	
1931	3	48	------
1932	5	26	------
1933	6	40	------
1934	6	21	------
1935	4	58	------
1936	7	124	------
1937	8	83	------
1938	6	64	
1939	6	84	
1940	10	82	
1941	14	129	
1942	14	157	
1943	13	178	
1944	10	189	
1945	14	119	
1946	10	64	
1947	13	91	
1948	11	67	
1949	11	74	
1950	11	83	
1951	14	96	
1952	16	116	
1953	15	214	
1954	12	119	
1955	21	105	
1956	20	146	